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Six Construction Mistakes in One Concrete Road

By Godfrey L. Smith

Broken Section of 36-Inch Pipe Burned Out Under 50 Feet of Water

By William W. Brush

New Type of Bascule River Rouge Bridge of the Wabash Railway

Proposed Additional Water Supply for the Boston Metropolitan District and Worcester

And

Monthly Materials and Labor Prices

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ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

E. J. Mehren
Editor

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Los Angeles Sewage Dilemma

THE CITY authorities of Los Angeles are in a dilemma. After their engineering department gave warning that sewage-flooded streets were imminent because of the effect of increasing population on an outlet sewer at times running practically full, the voters last year for the third time defeated a bond issue for a new outlet sewer and sewage treatment, and this in the face of advice from the State Board of Health before the first vote that treatment was needed even then. The predicted happened a few weeks ago, as noted on p. 336 of our issue of Feb. 23. Sewage burst from manholes on the outfall sewer and flowed through the streets of Los Angeles. To meet the emergency, the sewer was tapped and sewage diverted into Ballona Creek. The State Board of Health has refused to sanction this expedient, even if the city screens and chlorinates the sewage. Property owners down the creek are seeking an injunction against using the creek as stated. What can city authorities confronted with such a dilemma do? At latest accounts they were getting legal opinion on the recommendation of the city engineer to disconnect enough of the more recent sewer connections to relieve the overflow. This or some other drastic action seems to be necessary to bring the voters of Los Angeles to a realizing sense of the threatening condition with which they are confronted. Meanwhile, people outside Los Angeles continue to wonder how such a situation could arise and continue.

Preparing Lawyers and Engineers

AT A MEETING in Washington last week representatives of more than 150 associations in the legal profession adopted the recommendation of the American Bar Association, that future members of the Bar must have at least two years of college education in addition to their regular law school work. The proposal was not without opposition, but was adopted because of the pleas of eminent lawyers that such a preliminary educational requirement was necessary in order to raise the standards of the profession. The action is not without interest to engineers, for the higher the standards of other professions are raised, the more exacting will have to become the qualifications of engineers if their professional standing is to be on a par with that of members of other professions. If the discussions resulting upon Prof. Burr's paper at New Haven last June are a true index of the feeling among engineering teachers, stiffer preliminary requirements to the study of engineering will meet with approval in the engineering colleges. We are probably not ready yet to follow the lawyers in demanding two years of college preparation, but certainly there should be steady encouragement to those who have the capacity and the time to prepare themselves for a broader engineering career by a combined six-year course in liberal and engineering studies.

At Last a Port of New York

THE integration of the Port of New York is an accomplished legal fact. Both states have put their final approval on the Port of New York Authority and that novel and powerful body is now able to function. Primarily this new body is a political experiment, for while its conduct must be on engineering and commercial bases, it is something entirely new in American government. For the first time we have a political unit geographically delimited by industrial conditions and not by historically established lines. The very novelty of the expedient, therefore, should tend toward cautious progress, because so many pitfalls in the way of precedent must be bypassed or crossed. The enabling acts of the Port Authority are by no means perfect. They make altogether too ironclad the precise engineering schemes to be followed in developing the port. The commissioners, being appointed by the governors, are not readily enough reached by the people, industries, or communities whom they will serve. Some middle ground of compromise must be reached by the Authority and the City of New York. Without this the port will go backward; that is, as fast as the resistless flow of commerce will permit. These things, however, are subordinate to the fact that at last there is promise of some orderly consideration of this great national asset and that the engineering disgrace of the separated port belongs to the past.

Advertising Speed Records

EQUIPMENT manufacturers who exploit performance records, and particularly isolated extraordinary performances, in advertising their product, are inviting disfavor instead of gaining credit. At the recent convention of the Associated General Contractors there was vigorous condemnation of the practice on several occasions, and the association formally adopted resolutions asking that such advertising be discouraged as misleading and vicious. So little is gained, ordinarily, by quoting high output figures, however true they may be, that the manufacturer cannot afford to challenge so strong a sentiment on the part of many of his customers. There have been some particularly far-fetched uses of speed-record figures to carry the claim for especial consideration of some make of equipment. Good equipment does not need the adventitious support of record runs to gain the attention of high-grade contractors. In fact, the tendency always is to discount them, for the contractor is all too conscious of the many factors that in practice affect the speed of work. Speed "bursts" are generally looked upon as freaks. Also a trained organization with inferior equipment often surpasses in speed the untrained organization with superior equipment. In brief, all his practical experience inclines the trained contractor to ignore statements of excessive performance records while the untrained contractor is misled into accepting them as common experience.

Doweled Pavement Joints Gain Favor

DOWELS have developed noteworthy prominence in the last year as a feature of joint construction for concrete pavements. In this issue an older example of the adoption of doweled joints is given, with evidence of their rather striking effectiveness in holding up an undermined road slab. There were probably previous uses of dowels in pavement joints, but any claim for precedence is secondary to the fact that their use was last year adopted in a number of individual designs and, in two cases, in standard designs of state highway departments. Invariably the purpose of the dowels has been to keep the opposing slab-ends from moving up and down independently, due to vehicle loads, slab warping or subgrade movements. Except in case of the longitudinal joint dowels used in Illinois, which are bonded into the concrete as solidly as may be, bond is eliminated by painting, by wrapping with paper, or by gas pipe sockets on one side of the joint. The New Jersey state requirements are fairly typical; they call for ¾-in. x 2-ft. bars wrapped in paper and set across the joint 1 ft. from each slab edge and then at 2-ft. intervals. With the increasing use of doweled joints highway research bodies have another problem to consider. Pronouncement is needed, first, on the question whether doweled joints are a real structural requirement, and second, on the question of preferable design and construction. At present engineers are guessing at both questions.

A Field Day for Honesty

HONEST contractors, honest material-men, and honest workmen all will profit by the changes in working rules established for the 119,000 members of the Bricklayers, Masons, and Plasterers International Union of America, as a result of certain conferences between the officials of that union, the United States District Attorney at New York and the Attorney General. These rules have been embodied in a consent decree which has been signed at Washington by government officials and union representatives and which will be entered forthwith in the United States District Court at New York. If all concerned will line up to the spirit of these rules honest contractors will be assured a fairer market for both labor and material, honest material-men will be free from the menace of trade blackmail and honest workmen will be released from the hobbles that have penalized efficiency and stifled ambition. Everybody, in fact, will profit except the crooks.

To have been present during the conferences that led to this happy outcome would have been interesting. We should like to have heard what was said. We surmise that we might have discovered on the one hand an impelling quality, reminiscent of Davy Crockett, and on the other a certain tardy discretion suggestive of the treed "coon" that petitioned Davy not to shoot, as under all the circumstances, he had decided it would be better to come down.

Howbeit, the results are what matter. It is to be hoped that having demonstrated his prowess in this little encounter, our own Davy will seek out an opportunity to try his persuasive powers on other and perhaps heavier game, and that he may find a way to abolish the restrictive powers of other labor unions. If this can be done, persistently and fearlessly, the field of building and general construction may yet be made safe for honesty.

Methods or Results

AT ALL of the public hearings on the tentative specifications prepared by the Joint Committee on Concrete and Reinforced Concrete, there has been violent opposition on the part of contractors to the alternative proportioning clause which puts the responsibility for the strength of concrete upon the contractor. Such opposition is well founded not only because such a clause, in the present state of the art of making and testing concrete, would be practically impossible to maintain in the courts but because it takes away from the engineer the exercise of the judgment and discretion necessary to achieve his desired results. Curiously enough, however, one of the principal criticisms of other features of the specifications by some of these same contractors is that there is too much specifying by methods and not enough by results.

This incongruous position goes to the heart of the purposes of a specification. If it were possible to procure for an owner the kind of structure he wanted merely by stating what that structure is to be the engineer would be a superfluity, or at least his function would become merely the supervision of acceptance tests. It is because such tests can not be devised of sufficient scope and thoroughness to simulate all the varieties of service the structure must endure that the engineer must specify the way the work is to be done. The only alternative is to let the contractor do the specifying, which, however successful it may be in special cases, is unethical and in the long run dangerous.

This is of the very elements of the tripartite engineer-owner-contractor relation, but evidently it will bear repeating.

Boston District Water Question

UTILIZATION of "flood flows" instead of the common American practice of taking the stream flow up to the usual limit of economical storage, a reservoir of record-breaking size for a municipal water-supply project, and a large both-way-flow aqueduct are the most striking features in the report of the project for an additional water supply for the Boston Metropolitan District and the City of Worcester. The report is also significant for giving more consideration to filtration than is commonly expected in a Massachusetts State document. But filtration is merely recommended for the poorer existing sources "when needed" and recognized as ultimately required for all the surface supplies of the district.

In England, as also throughout the United States for water power, and in the West for irrigation, the utilization of "flood flows" only in order to disturb as little as may be lower riparian rights or, in the West, prior appropriations, is common enough. For American water supplies the practice is by no means unknown, but compensation in money rather than in water has been the general rule here when taking streams for public water supplies.

The decision of the Joint Board to advise immediate construction of the Ware unit only, the minority report by one member of the board being against even that until studies of storage on the Ware have been made, the strong feeling in some quarters against the invasion of Central Massachusetts for water, the plea for filtering nearer sources, and the optimistic hopes of at least a few that there can be further reduction in per capita

water consumption of so large a district when the rate is already down to less than 105 gal. a day, combine to make the fate of the project uncertain.

The final decision rests with the Legislature and depends upon its reaction to public and to official and scientific opinion. The whole matter may turn largely upon the reception of the proposal to take only the "flood flows." If this allays a considerable portion of the opposition from Central Massachusetts, and if the people of the state as a whole remain in their old faith in the preference for naturally safe rather than treated water supplies, then it seems likely that the Legislature will adopt the report—as it almost invariably adopted the recommendations of the State Board of Health and other boards or commissions which have advised it in the past on many important matters of public health and sanitation.

Facts About Muscle Shoals

LEAVING aside the sentimental regard in which the South now holds Henry Ford and the somewhat widely spread antipathy to the public utility company as such, it is proper to consider the plain facts of the two principal offers to the Government for the water power rights and the existing properties at Muscle Shoals on the Tennessee River. The first of these by Henry Ford proposes, as has already been stated in these columns, that the Government complete the two dams (at an estimated cost to the Government of $50,000,000) and that when complete the Ford company will take possession of the two dams, the two nitrate plants, the Waco limestone quarry, the steam power plants at Sheffield and at Gorgas and the transmission line between the two. For this the company will pay $5,000,000 cash and 4 per cent rent on new construction costs, say $2,000,000 a year, plus $24,000 a year amortization. The company would have a 100-year renewable lease and promises to operate one of the nitrate plants as a fertilizer factory, though the company's obligations in this respect are somewhat nebulous. The Government is to maintain the dams and is to be paid $55,000 a year therefor.

The Alabama Power Co. proposes to leave the nitrate plants and the Waco quarry to the Government, but agrees to take over the Wilson dam, as is, and complete it at the company's expense under the provisions of the Federal Water Power Act, with the usual 50-year recapture and rate regulation clauses. It offers to pay $5,000,000 for the steam plants and transmission lines and to turn over to the Government for the operation of the nitrate plants (or, if those prove impracticable, for commercial use) the second 100,000 hp. available at Wilson dam, which is designed for 600,000 hp. The company will maintain the dams at its own expense.

From a purely monetary point of view then in taking the Ford offer the Government would pay out another $50,000,000 and would get in return $5,000,000 cash and somewhat over $2,000,000 a year in perpetuity for giving up all but war-time rights at this site. It would also have the possibility of cheap fertilizer, but only the possibility. In accepting the A. P. C. offer the Government would give a regular federal water-power lease, reclaimable at 50 years, would not have to put up any more money, would get $5,000,000 cash and would receive 100,000 hp., worth at least $2,000,000 a year, which is a very fair rent and amortization payment for the $17,000,000 already spent on the Wilson dam works. It would still have the nitrate plant to operate or to seek an operator for.

There is no question that the latter is the better offer as a business proposition. If Congress is to be persuaded by the glamour of Henry Ford's name; if it thinks that the company he forms will perpetuate for all time the altruistic community development he proposes or if it thinks that only by him can the fertilizer possibilities of Muscle Shoals be developed, those features would weigh heavily in favor of the Detroit man's proposition. If on the other hand if it wants to make a favorable business deal which returns a proper proportion of the excessive war costs of the plants and guarantees a just and legal control of federal water power it will take the Alabama Power Co.'s offer.

Electric Torch for Under-Water Metal Cutting

MARINE salvage practice has been drawn upon successfully for handling an unusual job of emergency water-works repair. Last month a section of the 36-in. subaqueous cast-iron pipe line delivering Catskill water from Brooklyn under the Narrows to Staten Island, New York City, was smashed by the spud of a dredge. The break occurred at a depth of 50 ft. and the problem was to remove the damaged section, replace it with a new length of pipe, and get the line back into service at the earliest possible date. The novel and outstanding feature of the operations, described in detail by Mr. Brush elsewhere in this issue, was the use of an under-water electric torch for cutting out the broken section of pipe, which had a minimum thickness of 1⅛ in. To have attempted this work by drilling or other cutting methods would have been a slow and tedious process. With the electric torch, however, the damaged section of pipe had been removed nine days after the burning began.

In ordinary water-works practice such methods as were employed on the Narrows siphon will rarely be used, but the under-water cutting of metal has many other engineering applications, and the effectiveness of the tool developed for such work has been demonstrated not only on the Narrows siphon job but on a number of ship-salvage operations. It was for the latter type of work, in fact, that the electric torch was primarily developed. It was employed in salvaging the steamship "St. Paul," which turned over on her side at a North River pier in New York, April 25, 1918; here the under-water torch was used to cut large drainage holes between compartments. Again, in raising the army transport "America," which listed and sank at her pier Oct. 16, 1918, drainage holes were cut under water through a number of bulkheads. When the "Aquitania" cut through the "Lord Dufferin" Feb. 28, 1919, a large section of bent plating on the latter was cut off.

The original construction of the Narrows siphon, involving the use of especially designed flexible-joint pipe sections, laid by means of a huge steel cradle extending from a scow to the harbor bottom, presented a variety of new construction problems. The repair work now nearing completion has been done by methods as distinctly out of the ordinary as those of the earlier contract. While both rolled and cast steel had previously been cut under water by the electric torch, the Narrows siphon work represents the first successful submarine burning of the much more refractory material, cast iron.

Broken Section of 36-In. Pipe Line Burned Out by Electric Torch Under 50 Ft. of Water

Repairs to Narrows Submarine Siphon of New York's Catskill Water Supply System Develop Methods Without Precedent

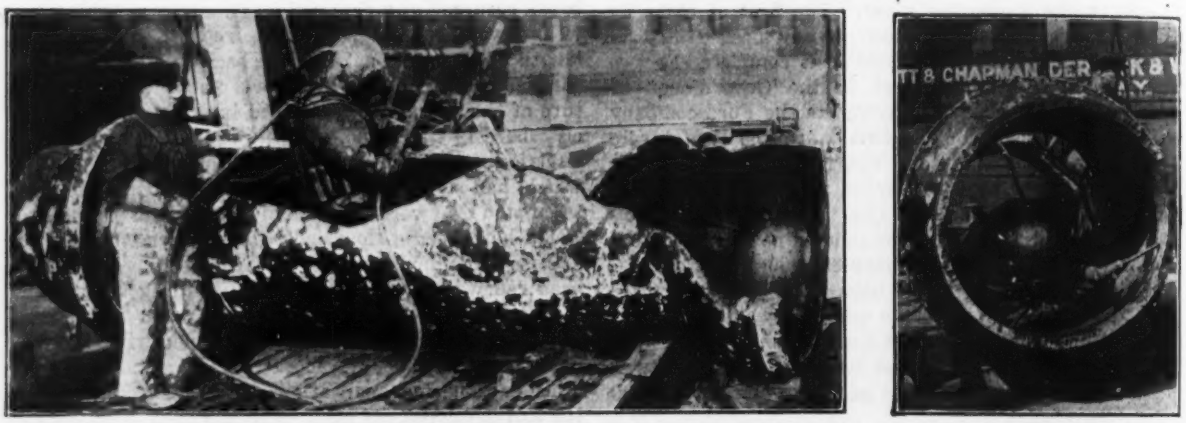
By William W. Brush
Deputy Chief Engineer, Department of Water Supply, Gas and Electricity, New York City

By the use of an electric torch specially designed for submarine cutting operations and operated by divers at a depth of 50 ft. below the surface of New York Harbor, a section of the 36-in. flexible-joint, cast-iron pipe line conveying New York City's Catskill water supply from Brooklyn underneath the Narrows to Staten Island, broken by the spud of a large dredge Feb. 2, has been removed and replaced with a new pipe length joined to the existing line by means of a cast-steel sleeve. The methods employed for restoring the damaged subaqueous pipe line to service constitute a radical departure from the ordinary practice of emergency water-supply repair work.

The submerged pipe line, known as the Narrows siphon, is made up of 12-ft. flexible-jointed sections, is about 10,000 ft. in length from 79th St., Brooklyn, to Arietta St., Richmond, and was laid in 1914-1916 by the Board of Water Supply of the City of New York as part of the Catskill delivery system. The contractor was the Merritt & Chapman Derrick and Wrecking Co. and the contract price for the original construction was about $1,000,000; the line was described in *Engineering Record* of Dec. 19, 1914, p. 656.

The large dipper dredge "Toledo," working under the direction of the city dock department on Feb. 2, was deepening the waterway in the slip at the foot of Arietta St. just north of the most northerly of the new Stapleton piers and it seems likely that one of her heavy spuds either came in contact with or was very near the pipe line, the break occurring at noon in the immediate vicinity of the dredge. The approximate location of the break was shown by the water boiling up at the surface from a flow of about 28 million gallons daily, which is about twice the normal flow, and this location was later confirmed when air was pumped into the pipe. The break was about 170 ft. from the Richmond shore, where the earth cover was about 20 ft., and the total depth of water to the pipe just over 50 ft. The Merritt & Chapman company was immediately asked to undertake the work of repair, and had its derricks on the job within 3 hours after the break occurred. This company has since continued work on the repairs, working double shifts.

Removing the Broken Pipe.—In three days the dredging, directed by divers, had uncovered the pipe sufficiently to determine that there was a large hole in one length, and that this length would have to be completely covered by a sleeve, or else removed and replaced. The Board of Water Supply in 1917 had designed a special split cast-steel sleeve, made up in twelve pieces, to cover two bells and the intervening length of pipe, but this sleeve was not carried in stock, and the estimate of time to fabricate it was three weeks. One of these sleeves was immediately ordered to be used if required, and the contractor was directed to remove the broken pipe and replace it with a new length of pipe, using a cast-steel sleeve to connect the two ends. A split and also a solid steel sleeve 5 ft. long were ordered, it being intended to use whichever one could most readily be placed.



DIVER IN BROKEN PIPE ILLUSTRATING USE OF ELECTRIC TORCH IN MAKING OUTSIDE AND INSIDE CUTS

Electric Torch Methods.—The Merritt & Chapman company had started experimenting with burning cast-iron under water as soon as the order to make the repair had been given, and reported that the cast-iron could be cut with its patented under-water burning torch in considerably less time than it could be drilled or otherwise cut.

On Feb. 9 the burning of the iron was started, using one electric torch, and in a few hours the wrought-iron band 1½ x 4 in. was removed. Two torches were placed on the work Feb. 10 and kept in use for about 20 hours each day. The torches were operated by three divers assigned to each torch for each shift, it being necessary to relieve a diver after about 2 hours' work, due to the

freezing temperature of the water. Each diver was submerged for about 6 hours on each shift.

The burning of the pipe was continued until noon Feb. 19, or virtually for 9 days, when the section of the broken pipe and the adjacent bell were wedged free, and that afternoon the broken pipe was raised to the surface in the condition shown by the photographs.

To remove the pipe it was decided to cut off the upper

SHOWING CUT MADE BACK OF HUB, AT BEVEL OF 10 IN.

half of the bell of the broken pipe and to cut through the undamaged pipe next to the broken pipe just back of the bell, making the cut with about a 10-in. bevel to facilitate removing the cut section. In addition to this cutting work it was necessary to cut out a section roughly 12 x 25 in. to give room for the divers to get into the pipe to make the bottom cut. The divers cannot effectively operate the cutting torch above the shoulder level, and this limitation, together with the possibility of damaging the bell, formed the basis for the decision to cut off the adjacent bell rather than attempt to cut out the spigot end of the broken pipe. The pipe is 1⅛ in. thick, with the bell varying from 1⅛ to 3½ in. The total length of cutting was about 230 in. of 1⅛ in. metal, 30 in. of heavier metal up to 3½ in. thick, and 8 in. of wrought iron 1½ in. thick.

Burning Cast Iron a New Development

The cutting of the cast-iron under water by burning the metal is a new development. Both rolled and cast steel had previously been cut under water, but cast iron is so much more refractory that it seemed doubtful whether it could be successfully burned under water.

The first burning out of steel under water was done by the Merritt & Chapman organization in raising the steamer "St. Paul" in 1918, when steel plates and steel hawsers were successfully cut under water by burning. Since then both rolled and cast steel have been burned by this company on wrecking jobs, but no cast iron was encountered until the Narrows pipe line broke.

The relative speed of cutting iron by drilling and reaming and by burning was illustrated in the fall of 1918 in salvaging the "America." Two U. S. Navy divers, operating pneumatic drills and reamers, and relieving one another on the work, cut in 5 days a hole about 15 in. in diameter in a ⅞-in. steel plate under about 30 ft. of water. At the same time the Merritt & Chapman company, in practically a single day, cut a similar sized hole in a ⅝-in. steel plate under about 60 ft. of water, using one diver; the cut plate was brought to the surface the morning after operations began.

The burning is accomplished by using a patented electric torch, known as the Chapman-Kirk torch, invented by Ralph E. Chapman and J. W. Kirk, and developed and perfected by Mr. Chapman. This torch consists of a carbon electrode which is bored for the passage of cutting gas, the carbon being connected to one pole of a generator, the other pole being grounded through the water to the metal to be cut. The current required for cast iron is about 350 amp. at 60 to 100 v., a lesser volume of current being required for steel. As no local current was available, generators were set up on a derrick barge.

The carbon of the torch is wrapped with insulating tape to reduce current leakage. The arc is formed by establishing contact and then withdrawing the carbon about ¼ in. The cutting gas plays against the metal at the point of the arc and the metal is volatilized. The water is kept away by the gases formed in cutting and the diver is not physically inconvenienced by either the heat or the light from the torch, but the intensity of the light prevents him observing the actual cutting of the metal. The wires carrying the current and the cutting gas are both conveyed through a rubber hose, and the carbon point is attached to the end of the hose by a special coupling. The diver signals when he wants the current and the cutting gas turned on and off. A carbon will last about 20 min., and while a diver may cut an inch in 10 min. an average of 2 in. per hour is considered very good progress with cast iron 1⅛ in. thick.

The diver utilizes a relatively large percentage of the time in cutting away the small sections of metal which are left between the holes on the far edge of the cut metal, the holes being cut completely through the metal on the first burning. As it is very hard for the diver to keep the torch in the right place, a wooden templet

CAST-STEEL SLEEVE FOR MAKING JOINT WHERE OLD AND NEW PIPE LENGTHS MEET

Note ring of 1-in. bolts to center sleeve around pipe leaving ¾-in. lead calking space.

is fastened to the pipe to act as a guide for the diver, and with such a guide a very close approximation to the line to be cut can be made by the divers who have to depend entirely upon the sense of touch, as they can see practically nothing, due to the mud in the water. The bevel cut back of the bell shown in one of the photographs well illustrates how closely the desired line is adhered to when a templet is used.

Replacement of Broken Pipe.—A new length of pipe was turned down on the spigot end for a distance of about 4 ft., and the enlarged grooved section which normally fits into the spherical bell was removed. A solid steel sleeve of the thickness of the cast-iron pipe

and 5 ft. long has been placed on the cut pipe now in place, and after the new pipe was properly fitted over the exposed spigot the sleeve was moved to cover the two smooth ends. Twelve 1-in. bolts spaced around each end of the sleeve about 5 in. therefrom and well covered with white lead to reduce leakage have been used to equalize the ¾-in. lead space between the sleeve and the pipe. An iron bar 2 in. wide by ½ in. thick, shaped to fit in back of the calking space, is placed against the bolts, which are 1 ft. apart, and thus forms a solid backing against which is calked lead wool to a depth of 3 in. A cast-steel gland or collar is drawn up against the lead joint by eight 1-in. bolts, and holds the sleeve joints from any possibility of blowing out.

The sleeve joint on the machined spigot end of the new pipe is equivalent to an expansion joint and it is believed will move if any settlement takes place. Neither the sleeve nor the glands will be coated, dependence against rapid corrosion being placed largely on the covering to be replaced over the pipe. The spherical flexible joint was made up with lead wool. After the repairs are completed the tightness of the joints will be tested with air pressure, the line will be blown out, sterilized by use of liquid chlorine, and then put in commission. The new pipe and the two adjacent lengths now in place will be thoroughly blocked up before the trench is backfilled. It is estimated that the cost of repairs to the pipe line will be approximately $60,000. It is expected that the line will be put back into service this week.

Reduced Consumption Urged

Water Supply Conditions.—The borough of Richmond (Staten Island), now has a population of about 120,000, and a normal consumption of 18 million gallons daily. When the 36-in. pipe line was laid the consumption was 12 million gallons daily and there was no indication of a sudden growth in population or consumption. This growth came as a result of the war, and as the pipe line can deliver about 13 million gallons daily with the available hydraulic gradient, the remainder is supplied by local pumping stations drawing from driven wells. The total capacity of the local stations is about 13 million gallons daily. The Board of Water Supply constructed as part of the Catskill system the Silver Lake reservoir, holding 438 million gallons, with a depth of 36 ft.

When the break occurred 40,000 circulars were printed explaining the situation and asking the people to co-operate, these circulars being placed in the houses and also given to each school child. Pressures were reduced about 15 lb., but as pressures are generally 50 lb. or more this did not curtail the supply for many persons. For a few days there was a reduction in consumption of about 3 million gallons daily, but this reduction gradually disappeared. It is believed that after the first few days few of the consumers paid any attention to the department's request to reduce waste and use of water. The reservoir has been lowered about 9 ft., and it is expected that the repairs will be completed by the time the reservoir level has descended about 11 ft. The local stations were all put back in service, one of them having been shut down for the past four years.

The Board of Water Supply under date of Jan. 23, 1922, requested the Board of Estimate and Apportionment to appropriate $5,537,300 for additional Catskill delivery mains in Brooklyn and Richmond, including a 42-in. flexible-joint pipe across the Narrows from Brooklyn to Richmond. This pipe line would have a capacity of about 20 million gallons daily, and when laid would provide for the increase in the consumption up to about 1930. No action has as yet been taken on this request.

Large Quarry Rock Crushing and Screening Plant

Million-Dollar Plant with Roll and Gyratory Crushers—Cable Incline and Conveying Belts—Gravity Switching

By Hilmar F. Smith
Supervising Engineer, Construction Division, Quartermaster Corps, U. S. A., Belleville, Ill.

TO SUPPLY oolitic limestone, averaging 98 per cent pure, for the U. S. Government Nitrate Plant No. 2, at Muscle Shoals, Ala., a quarry was opened at Waco, 30 miles distant, and equipped with a crushing and screening plant having a daily capacity of 2,000 tons. In the design of this plant, surplus material and supplies stored at Muscle Shoals were used as much as possible. The property is about ½ x 1½ miles in area, with a generally flat surface and a depth of loam and clay overburden ranging up to 8 ft. A 1½-mile spur track connects with the Northern Alabama R.R.

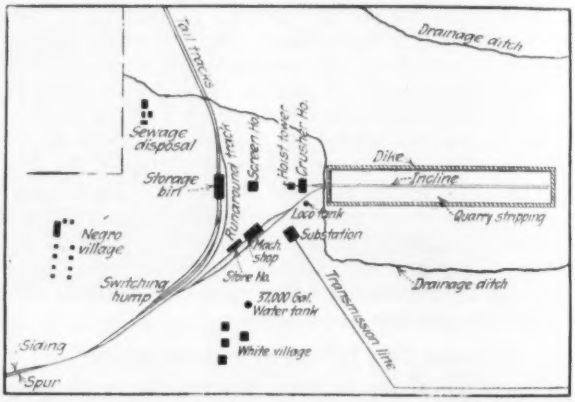


FIG. 1. LAYOUT OF QUARRY AND CRUSHING PLANT

Electric current for power and light is taken from a 110,000-volt transmission line ¾-mile distant, which line is owned by the government and supplied by the Alabama Power Co.

Included in the Waco quarry project were the following main features: (1) A negro village of ten small houses and a barracks for 29 men; (2) a white village of four bungalows; (3) a water-supply system and sewerage system with disposal plant; (4) a machine shop, storehouse, powderhouse, crusher building, screen house, hoisting tower and storage bin; (5) stripping an area 200 x 1,400 ft. and opening a rock cut 30 x 1,000 ft. and 8 ft. deep; (6) building five miles of railroad and ten miles of fence; (7) erecting ¾ miles of 110,000-volt transmission line, with a 440-volt power system and 110-volt lighting system; (8) excavating drainage ditches to intercept surface water.

A layout plan is given in Fig. 1. From the spur the railway diverges, one line serving the machine shop and storehouse and extending about 1,000 ft. into the quarry. The other line swings round to the east, with

an ascending grade of 1½ per cent for 500 ft. to a switching hump or summit, followed by a similar descending grade 1,000 ft. long to the storage bin, beyond which is 1,000 ft. of tail tracks. A runaround track on the level connects the tail tracks with the main line. Three tracks on the hump provide for delivering empty cars by gravity to the stone bins or the dust bins, beyond which the loaded cars proceed by gravity movement to the tail tracks, on which trains of 20 cars are to be assembled. The trains will be hauled over the runaround track and along the spur to a storage yard at the connection with the Northern Alabama R.R.

From the plan and sectional elevation, Fig. 2, it will be seen that the 5,000-ton storage bin, screen house and crusher building are in line, connected by a conveyor structure. Beyond the crusher building a double-track incline of 20 per cent grade runs into the quarry. It is intended to finish the quarry floor to El. 645 or 60 ft. below the surface (El. 705), working down to this level by a central bench and two side benches, all 16 ft. deep, 30 ft. wide and 1,000 ft. long. At present only the first cut of the central bench is being opened, 8 x 30 ft. This will give eventually two faces 60 ft. high and 1,000 ft. long, from which the quarry will be widened toward the east and west boundaries.

To exclude surface water as far as possible the stripped area, 200 x 1,400 ft., is surrounded at a distance of approximately 500 ft. by about 10,000 ft. of drainage ditches, 2 ft. deep and 12 ft. top width, with the spoil bank on the quarry side. There is also a dike 8 ft. high and 20 ft. wide, built with the stripping.

Blasted rock is handled by a steamshovel of the railroad type with a 1-yd. bucket, loading 12-yd. dump cars which are hauled up the incline by a double-drum cable hoist with 150-hp. motor. An empty car descends as the loaded car ascends. At the crusher building the grade is reduced to 3 per cent, and as the car comes to rest over the track hopper it is dumped by hand by means of a pneumatic hoist.

The crusher house, 25 x 81 ft., has a concrete foundation and steel superstructure with corrugated iron sheathing. At one end are the two crusher motors and at the other end is the primary crusher, of the roll type, the middle being occupied by a secondary gyratory crusher. Stone from the track hopper is delivered to the rolls at El. 719. The product from these is discharged over an oscillating grizzly or screen 12 x 5 ft. at El. 708, the oversize spills into the gyratory crushers at El. 705. Fines from the rolls and the entire product of the gyratory are delivered to a 36-in. belt conveyor, the lower end of which is in a concrete tunnel.

As a protection against the pinching effect of the rolls, which at times causes them to eject heavy stones with great force, a 2½-ton counterweighted door of 3-in. plank covers the hopper. This opens when the car dumps a load of rock upon it but closes automatically when the rock has fallen through. The hopper is of steel, 8 x 22 ft. at top and 15 ft. deep with a bottom opening 8 x 14 ft. from which are suspended cast steel plates to guide the rock to the rolls. There are two rolls 4½ ft. in diameter and 4 ft. long, weighing 19½ tons each and revolving at 225 r.p.m., with an 11-in. space between their faces. This crusher, with a capacity of 1,000 tons per hour, is driven by a 250-hp. motor.

An oscillating grizzly set at an incline of 38 deg. and having bars spaced to give openings 4½ x 7 in., receives the crusher product, the undersize or fines passing through to the 36-in. belt conveyor which carries the discharge from the gyratory. The oversize goes to the gyratory crusher, driven by a 250 hp. motor and giving a product of 3¾-in. to 6¼-in. size at a rate of 525 tons per hour. This product is fed to the 36-in. belt conveyor traveling on a grade of 30 per cent into the screen house.

Timber construction with corrugated iron sheathing is used for the screen house, 60 x 44 ft., the conveyors entering at the top and delivering the stone to two rotary screens 5 ft. in diameter and 24 ft. long, pitched 1½ in. per foot. A stone jacket with 3-in. openings extends

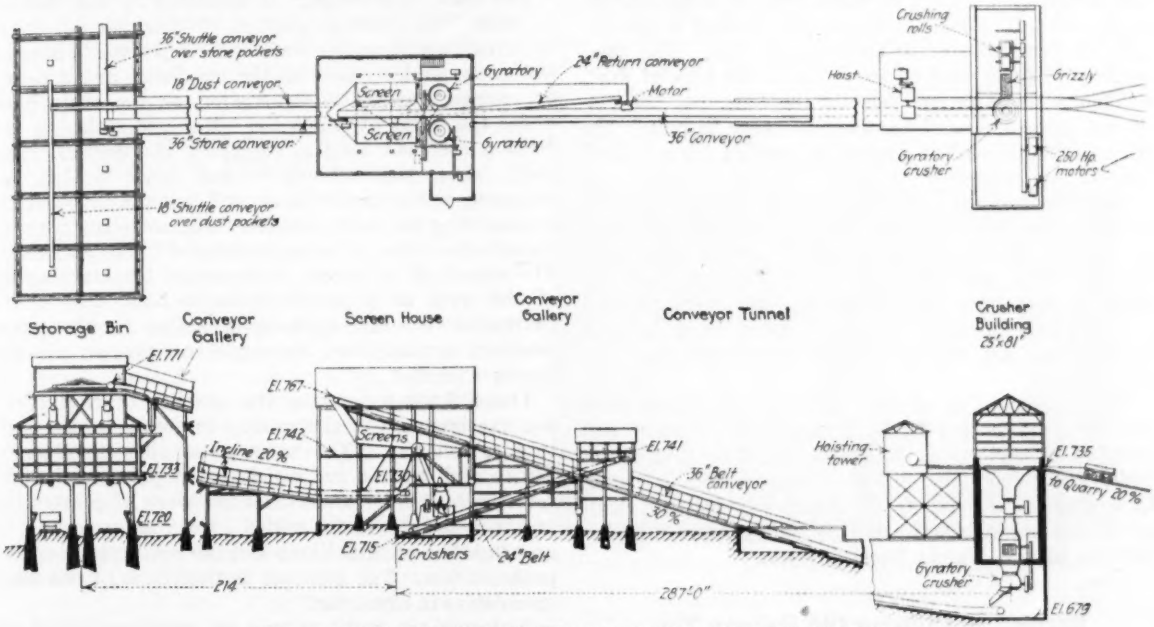


FIG. 2. CRUSHING AND SCREENING PLANT AND STORAGE BIN

the full length of the screen, and around this for half its length is a dust jacket with ½-in. openings. Each screen is driven at 12 r.p.m. by a 50-hp. motor. Oversize from the screens goes to two gyratory crushers having an output of 50 to 90 tons per hour of 2- to 3½-in. product, each driven by a 50-hp. motor. Their product is delivered to a 24-in. belt, inclined 30 per cent and discharging onto the main 36-in. belt from the crusher building for rescreening. All belt speeds are 250 ft. per minute.

Dust and 2½-in. stone from the rotary screens are delivered on 18-in. and 36-in. belts respectively (inclined 20 per cent) to the headhouse of the storage bin. This bin, 142 x 46 ft., is of heavy timber construction on concrete piers, with a floor of 12 x 12-in. timbers 48 ft. long. The two conveyors deliver their loads to lateral shuttle conveyors of the same size for distribution in the bins. Each of these shuttle conveyors can be operated in either direction and shifted longitudinally on tracks so as to cover seven bins. The total capacity is 2,000 tons of stone and 2,000 tons of dust. No hopper bottoms are used in the bins, but the discharge gates are set 7 ft. apart in order to reduce the dead storage to as low a point as possible for a cubical bin.

The crushing rolls, the two smaller crushers and the rotary screens were already on hand, and only the large gyratory crusher was purchased. Long conveyor belts were preferred to bucket conveyors or elevators as less liable to breakage. Cubical storage bins were adopted as it was considered that stone should form its own wearing surface, and this design gave a cheaper construction.

This million-dollar quarry and crushing layout plant was designed by the U. S. Ordnance Department and installed by Arthur G. McKee & Co., Cleveland, Ohio, under the supervision of the Construction Division, Quartermaster Corps, U. S. Army. It has not been put in operation, but is awaiting the government's disposition of the Muscle Shoals project.

Burning or Utilizing Old Railway Ties

Disposal of old ties by burning is not waste but an economic necessity in most cases, according to a statement by Samuel Porcher, general purchasing agent of the Pennsylvania Railway System. Although many old ties are sold as firewood at nominal prices to persons living near the right of way, this is only practicable where the ties can be delivered at a road crossing or other safe point for removal, and when this cost of delivery does not exceed the price paid by the purchaser. It would be dangerous practice to permit people to go on the track or through yards to gather up old ties, as such practice would only encourage trespassing, which is already a cause of frequent accidents. Dealers in firewood have little interest in the ties as they are dirty, partly decayed and dried out so that the wood burns too rapidly, and they contain more or less stone and old spikes which would be likely to damage the saws used for cutting up the wood. Attempts to dispose of the ties for the manufacture of pulp wood, charcoal and fertilizer ashes, or for the extraction of chemicals have been unsuccessful. As a rule, burning the ties on the right of way is the only practicable and economical method of disposal.

Defines Professional Attitude Toward Contracting

Institute of Consulting Engineers Distinguishes Between Professional Engineering and Contracting Functions

"WHAT is contracting? And what shall be the attitude of the Engineering Profession toward it as an occupation?" These questions have been answered recently by the American Institute of Consulting Engineers in order to interpret that provision of its constitution which declares ineligible for membership "engineers employed upon or connected with contracting or promotion, except in a strictly advisory or supervisory capacity where compensation is for professional service and not contingent upon profits."

The word "contracting" is restricted by the institute to mean "the common practice of carrying out public or private construction work under agreements between the owner or his agent on the one hand, and a person or company, called the *contractor*, on the other hand, under the terms of which the latter undertakes to perform a specified service, supplying the devices, materials, labor, superintendence and funds needed, and assuming the responsibilities and hazards involved, for constructing the work complete; and accepting payment therefore at rates or prices stipulated in the agreement. The object of the owner is to secure the carrying out of the work at a pre-determinable cost; that of the contractor to secure such compensation for the service rendered as shall cover the actual cost plus an adequate business profit."

The difference between the practice of engineering and the business of contracting is stated by the institute as follows: "The *engineer* supplies disinterested advice and service for which he is paid a stipulated fee; the *contractor* undertakes the work of construction at his own expense for stated prices, assuming all the uncertainties of actual cost and the contingency of final profit or loss. The business is therefore, in one sense, speculative in character."

Although the institute sees no moral or ethical reason why an engineer should not engage in a legitimate contracting business "independent of or in addition to, but *dissociated from* his professional work," it considers that it should be "distinctly held to be a violation of professional ethics for the engineer to undertake contracts for the construction of works, the plans and specifications for which have been prepared by him in his capacity of professional engineer. That the engineer in his capacity of a trusted counsellor to the client should be absolutely free from considerations of personal profit that may tempt him to sacrifice the interests of the client, is a cardinal principle of professional ethics recognized by all."

Whenever, in special cases, a client desires to place a designing engineer in executive control of construction work the engineer may act in that capacity, provided that "the client supplies the money to meet all current expenditures and assumes the contingencies involved; and the engineer's compensation is arranged on a fee basis, independent of questions of personal profit or loss."

If, however, the client desires the engineer to design and construct a work or plan for a specific purpose

"the engineer practically assuming in the construction work the rôle of contractor with its accompanying responsibilities and hazards and being compensated therefore, inclusive of the purely engineering service, in some one of the ways common in contracting," such an engagement "should be regarded as *contracting* rather than as *professional engineering*, for the contracting work will usually be of much greater financial magnitude than the engineering, and the practice may not be free from motives of business profit."

The institute modifies this provision, however, "in the case of the mechanical engineer connected with or interested in a manufacturing concern, who designs the standard or special devices or machines, made and offered or sold, upon their merits, to the trade or the individual client, in open competition with other concerns." Here the purchaser may exercise his own judgment assisted if he so desires by a disinterested expert, and the designing engineer is not retained by the client in the capacity of professional adviser. Such occupation and conduct is considered proper and ethical.

Revamping the Artesian Water Supply of Bryan, Ohio

THE water supply of Bryan, Ohio, is from a group of eight artesian wells connected to a 10-in. suction line 2,100 ft. long. From the construction of the works in 1892 until 1921 this suction line was direct connected to centrifugal pumps which supplied the town by direct pressure. The well pressure had always been sufficient to prime the pumps and the quantity large enough for domestic needs, but were not sufficient for fire purposes. To remedy this condition a 1,000,000-gal. circular reinforced-concrete reservoir has been constructed adjacent to the pumping station.

The reservoir is connected to the suction line by three 12-in. pipes so valved that the following can be done: Pipe 1 may be used to fill or partly fill the reservoir by direct pressure from the wells. Pipe 2 may be used to fill the reservoir full, as there is a centrifugal booster pump in this line. Pipe 3 connects the reservoir with the pumps in the station.

After 18 months service it has been found that the natural flow and pressure from the wells is sufficient to keep the reservoir from three-fourths to seven-eighths full except for the months of June, July and August, during which period it is necessary to use the booster pump.

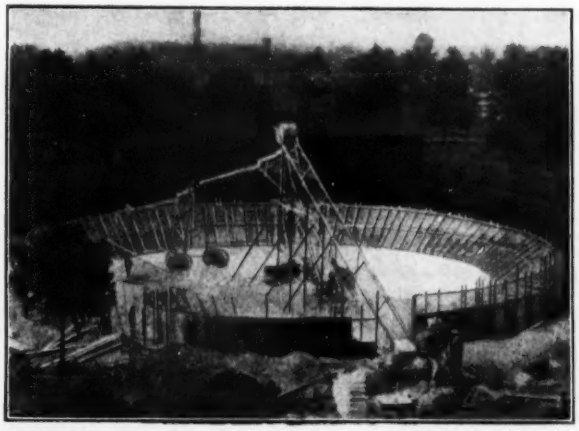
Three benefits were obtained by the construction of the reservoir, namely: (1) A 1,000,000-gal. fire reserve was obtained; (2) a well-water temperature of 52 deg. F. has been maintained in the distributing system; and (3) the flow of a large number of privately owned wells in the city has been restored and steadied during the summer months.

The reservoir is 100 ft. in diameter and has an effective depth of 17 ft., 10 ft. of which is below the ground level. Earth is banked around the sides so that only the concrete roof is exposed to sun and weather. The reservoir was constructed by excavating a circular trench for the walls in a clay which stands well when dry but caves badly when wet. The entire circular wall was then built in this trench, two openings being left in the wall through which the remainder of the earth excavated was taken by teams and slips and banked up on the outside of the wall. A concrete distribution tower was erected at the center of the reservoir with a chute mounted on a truck leading to the wall. Concrete was mixed outside of the wall and dispatched to the tower in a bucket running on an inclined track. After 12 months' service the reservoir has shown absolute water tightness.

The total cost of the reservoir, including a small enclosure for the booster pump and pipes, was $23,700.

This group of wells is located in a water-bearing belt 40 to 50 miles long and several miles wide, in which flowing wells are easily obtained at a depth of from 60 to 100 ft. The water-bearing stratum of gravel and sand is overlaid with a 60-ft. clay blanket, making the possibility of surface contamination remote, particularly when the water is under head. Repeated tests by the State Board of Health indicate an excellent uncontaminated quality, although the water does contain enough iron to stain porcelain fixtures.

Tests of two 10-in. wells 100 ft. deep put down in 1920 showed a yield of 400 gal. per minute with a drop of 7 ft. and 165 gal. with a drop of 6½ ft., the wells being pumped singly. The pumping of well 1 lowered



POURING THE WALLS OF A MILLION GALLON RESERVOIR
Concrete mixed outside wall, hauled up inclined track to central tower and distributed to walls through chute carried around circle on wagon trucks.

the water level 30 in. in well 2, which is 135 ft. away.

The lower 40 ft. of the 10-in. well casings were pierced with ⅜-in. holes spaced on 2-in. centers. Heavy pumping removes the fine sand and builds up a screen or filter of gravel on the outside of the casing.

As the demand increases this group of wells will become inadequate and ultimately new territory will have to be drilled and the suction line rebuilt and extended. Should the natural head become insufficient to fill the reservoir, a booster substation will be built in the new territory. No other supply is available for Bryan as there are no streams and the topography is too flat for an impounding reservoir.

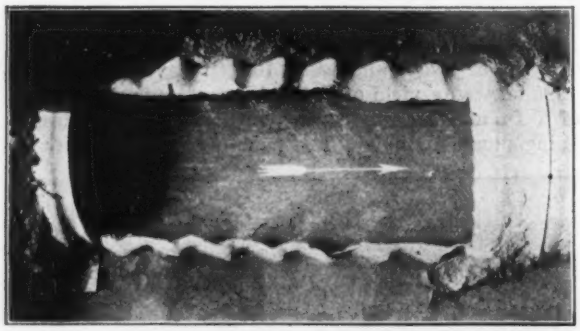
Conservation is being practiced through metering 98 per cent of the 865 taps, which brings the total summer consumption to 100 gal. per capita for the 4,250 population, with a day maximum of 150 gal. and a night minimum of 50 gal. About half of this consumption is domestic, the remainder being industrial.

The work of revamping the system and constructing the reservoir was carried out under the direction of to A. H. Smith Co., consulting engineers, Toledo. The Toledo Residence Construction Co., Toledo, was contractor. S. Folk is superintendent of water-works.

The Coefficient of Roughness in Corrugated-Iron Pipe

By D. L. Yarnell
Senior Drainage Engineer Bureau of Public Roads, U. S. Department of Agriculture

TO DETERMINE the coefficient of roughness applicable to corrugated-iron pipe, experiments on two sizes, 8- and 10-in., recently were made by the Bureau of Public Roads, U. S. Department of Agriculture. The actual (smallest) internal diameters of the pipes were determined by making two measurements at right angles to each other, at both ends of each section of pipe. In the commercial 8-in. pipe, the actual average diameter measured $\frac{3}{4}$ in. greater than the commercial size. The 10-in. pipe measured $\frac{3}{4}$ in. over the commercial size.



FILAMENTS OF FLOW IN 10-IN. CORRUGATED-IRON PIPE ON 1.25 PER CENT GRADE

In all, 147 tests were made. Nine grades were used, ranging from 0.05 to 1.50 per cent. For each size and grade it was planned to make tests at depths of flow of $\frac{1}{4}$, $\frac{3}{4}$ and $\frac{1}{2}$ the internal diameter of the pipe, and for other depths ranging from half full to full by successive increases of 5 per cent of the diameter.

ELEMENTS OF EXPERIMENTS FOR DETERMINING THE COEFFICIENT OF ROUGHNESS IN CORRUGATED IRON PIPE.

Depth of Flow (d) Ft.	$\frac{d}{D}$	Area of Flow (a) Sq. Ft.	$\frac{a}{A}$	Hydraulic Radius (R) Ft.	Discharge (Q) Cu. Ft. per Sec.	Velocity (V) Ft. per Sec.	Slope (s)	Kutter Coefficient (n)	Chezy Coefficient (C)
8-In. Pipe: Commercial Diameter, 0.667 ft.; measured diameter, 0.740 ft.									
0.709	.96	0.4239	.99	.2099	.2424	0.572	0.0005	.0170	55.8
.734	.99	.4295	.99	.1950	.3222	.750	.0010	.0175	53.7
.740	1.00	.4301	1.00	.1850	.4542	1.056	.0020	.0171	54.9
.740	1.00	.4301	1.00	.1850	.5540	1.288	.0030	.0171	54.7
.740	1.00	.4301	1.00	.1850	.7195	1.673	.0050	.0171	55.0
.734	.99	.4295	.99	.1949	.8444	1.966	.0075	.0181	51.4
.712	.96	.4248	.99	.2087	1.0261	2.415	.0100	.0179	52.9
.721	.97	.4271	.99	.2046	1.057	2.475	.0125	.0192	49.0
.700	.95	.4211	.98	.2129	1.158	2.750	.0150	.0193	48.7
10-In. Pipe: Commercial Diameter, 0.833 ft.; measured diameter, 0.897 ft.									
.871	.97	.6266	.99	.2495	.3660	.584	.0005	.0187	52.3
.856	.95	.6216	.98	.2556	.4761	.766	.0010	.0206	47.9
.861	.96	.6234	.99	.2539	.6776	1.087	.0020	.0204	48.2
.864	.96	.6245	.99	.2526	.7932	1.270	.0030	.0214	46.2
.863	.96	.6241	.99	.2530	1.045	1.674	.0050	.0206	47.1
.701	.78	.5299	.84	.2725	1.184	2.235	.0075	.0203	49.4
.683	.76	.5163	.82	.2714	1.3475	2.610	.0100	.0201	50.1

However, the capacity of the pumping plant proved insufficient to fill the larger pipe at the maximum grades. The results of the tests for the pipe flowing full at the various grades are shown in the table.

In order actually to observe in detail the flow of water in corrugated iron pipe, a section was cut from the top of the pipe and photographs taken of the flow in the pipe at about one-half full. The breaking up of the filaments of flow can be seen plainly in the accompanying view. This disturbance of the flow in the pipe, due to the corrugations, undoubtedly is the reason for the comparatively high coefficients of roughness in such pipe.

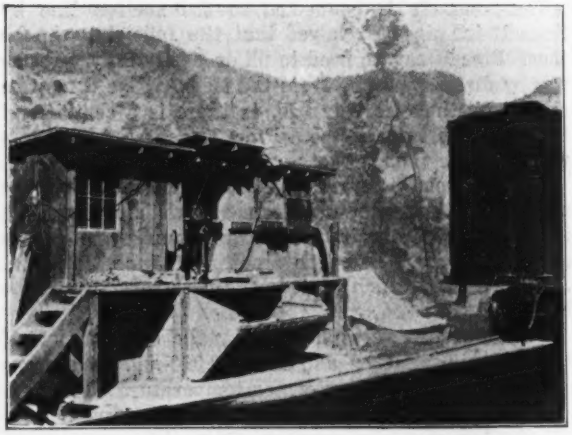
The values for the Kutter coefficient of roughness ranged from 0.017 to 0.021 for corrugated iron pipe flowing full (see table). No explanation is offered for the rather consistent variation in n as between the 8-in. and the 10-in. pipe.

Cement Handled in Bulk on the Hetch Hetchy Dam

Cars Unloaded With Flat Scraper for 15 Cents Per Ton—Manual Control of Weighing Machine Quicker Than Automatic Device

By N. A. Eckart
Chief Assistant Engineer, Hetch Hetchy Water Project

CEMENT is being handled in bulk on the new Hetch Hetchy Dam, east of San Francisco, and being proportioned for the mixer by weight. The Utah Construction Co., which has the contract for building the dam as a part of the new water-supply system for San Francisco, decided upon this system as the most economical and convenient method for this job which involves placing 370,000 cu.yd. of concrete on a schedule of 1,000 cu.yd. per day. At present 5 to 6 cars of cement, averaging from 176 to 265 bbl. per car are unloaded every day at the dam. Ordinary box cars are used without any preparation other than partial lining with building paper where the car floors or sides are not tight. These cars are loaded at the mill from sealed bins, the cement in which has been tested in the city's laboratories so that except for occasional check tests from the job storage bin, no further sampling is necessary.

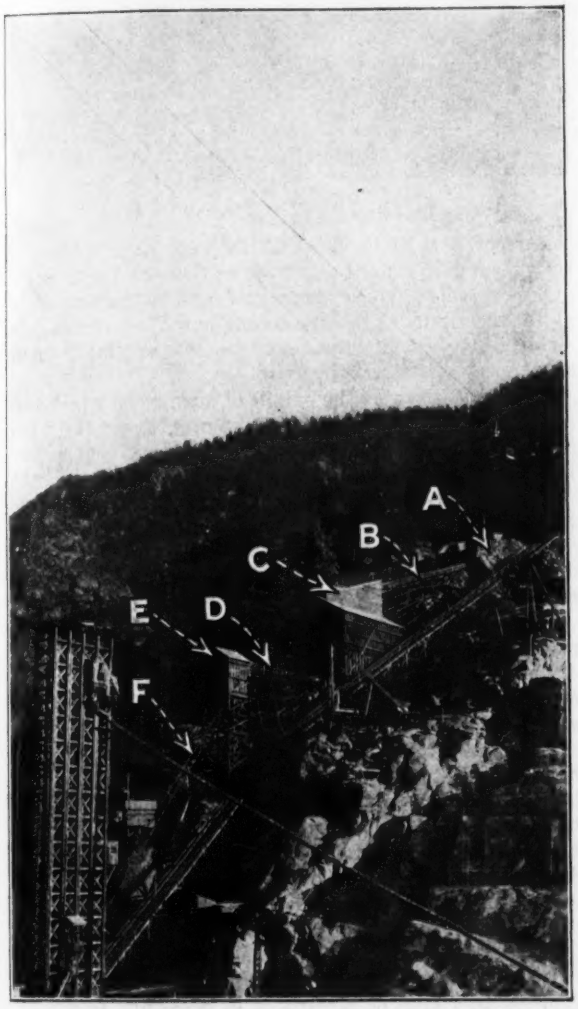


CEMENT RECEIVING HOPPER ON HETCH HETCHY R.R. SIDING

The cars of cement are delivered via the Hetch Hetchy R.R. to a siding just above the main storage bin at the dam site and are spotted opposite the unloading hopper shown in the accompanying picture. This hopper is hinged so it can be drawn into the clear under

the building platform until after the car has been spotted when it is swung out directly under the side door of the car.

Just above the hopper is a small motor-operated winch with a friction drum which is used to drag a light flat board scraper working inside the car and scraping the cement to the door. The unloading is done under contract on a basis of 15 cents per ton, this price covering the spotting of the cars, unloading and payment of demurrage when any accrues due to delay in unloading. Three men are able to take care of the



GENERAL VIEW OF CEMENT HANDLING SYSTEM, HETCH HETCHY DAM

A—Unloading hopper. B—Screw conveyor. C—Main storage bin. D—Screw conveyor. E—Weighing shed. F—8-in. pipes to mixers.

cement as it comes in, unloading by actual timing, 7 cars in nine hours, or approximately 200 bbl. per hour. While working in the car ordinary dust masks or muzzles are worn.

From the receiving hopper the cement is delivered to the main storage bin by means of a 12-in. screw conveyer, approximately 200 ft. long driven by a 15-hp. motor. The main storage bin is 60 ft. long, 32 ft. wide and 34 ft. deep, with a capacity of 13,000 bbl.

From the main storage bin the cement is moved on to the weighing shed a distance of about 120 ft. by means of a second screw conveyor. This conveyor runs underneath the storage bin in a 4 x 6-ft. tunnel along the sides of which are a number of slide gates controlling the rate of speed from the bin to the screw conveyor and permitting cement to be drawn from any section of the bin.

This screw conveyor delivers into a small hopper or bin just above the weighing machine and which has a capacity of about 60 bbl. The weighing machines were made by the Hoepner Automatic Scale Co. of Chicago and have a capacity per batch of 1,200 lb. each. The automatic feature is not now being used as it was found that with the machines as installed the rate of weighing can be increased by manual control from about 20 to 30 batches per hour per machine. When using the 1:2½:5 mix each batch requires 902½ lb. of cement; with the 1:3:6 mix 752 lb. of cement are required. From the weighing machines cement is discharged directly to the mixers through two 8-in. steel pipes supported by cables on a 1 to 1 slope.

Communication between mixers and weighing shed is maintained by telephone, as well as by signal horn and flash lamps, the purpose of these alternatives being to make certain that the cement charge can be varied at will for a change of mix without loss of time. The concrete mixers used have a capacity of 2 cu.yd., are motor driven and have hydraulickally-controlled charging gates. To date approximately 80,000 cu.yd. have been poured and the method of handling the cement has proved entirely satisfactory.

The construction of the Hetch Hetchy Dam is being carried on by the Utah Construction Co. under the general direction of M. M. O'Shaughnessy, city engineer. C. R. Rankin is construction engineer, locally in charge for the city.

An Insurance Company's Recent Housing Loans

The reported willingness of the Metropolitan Life Insurance Co. of New York City to finance housing in New York State to the extent of $100,000,000, provided the State Legislature would amend the insurance law so as to permit life insurance companies to invest 10 per cent of their assets in housing, led *Engineering News-Record* to request a statement as to the housing loans made by the company in the last two years. Walter Stabler, comptroller of the company, in reply states that from Jan. 1, 1920, to Dec. 16, 1921, the company loaned or pledged itself to loan a total of $68,080,107 to house 17,744 families. The division of these totals between New York City and all other cities, and between dwellings and apartments is given in the accompanying table:

SUMMARY OF HOUSING LOANS MADE OR PLEDGED BY METROPOLITAN LIFE INSURANCE CO., JAN. 1, 1920, TO DEC. 16, 1921

NEW YORK CITY		
555 Dwellings accommodating	826 Families	$3,456,700
294 Apartments accommodating	9,775 Families	42,223,500
	10,60	$45,680,200
ALL OTHER CITIES		
4,513 Dwellings accommodating	4,556 Families	$15,317,657
295 Apartments accommodating	2,587 Families	7,082,250
	7,143 Families	$22,399,907
GRAND TOTAL		
5,068 Dwellings	5,382 Families	$18,774,357
589 Apartments	12,362 Families	49,205,750
	17,744 Families	$68,080,107

Controlling a Mountain Torrent in Switzerland

History of Check Dams and Channel Regulation on Lammbach Creek and Results After 24 Years of Control

By Karl Haller

Doctor of Engineering, Langenau in Wurtemberg, Germany

Mountain torrent control and the regulation of small flashy streams is a very important class of engineering work that has not been extensively practiced in this country except, to some degree, in southern California. In Switzerland, however, conditions are such that it has long been a problem requiring constant solution. The following description of the control of a typical Swiss mountain stream should prove of value to American engineers contemplating similar work.—Editor.

As a result of atmospheric conditions in mountains, particularly high mountains, there occur formations of torrents, which in the course of time cut more and more into the mountain, disturbing thereby the state of equilibrium of the slopes on both sides and finally bringing about collapse of the mountain structure. The extent and danger of such a collapse as far as it affects the two slopes depends on the size and gradient of the torrent. It has happened, however, more than once that such mountain streams have carried away bridges, roads and indeed whole sections of the countryside. Such catastrophes usually occur after prolonged and extensive rainfalls or after excessively rapid melting of snow, and take the shape of a torrential movement of a mixture of water, earthy matter and stones.

FIG. 1. A SERIES OF CHECK DAMS ON LAMMBACH CREEK

The stream is partly dammed by massive detritus in the upper part of its flow, which holds back the water until gradually it finds a new outlet through the deposits and when this happens, the whole mass of water backed by the tremendous pressure accumulated back of the dam suddenly rushes into the valley below, carrying with it everything that stands in its way.

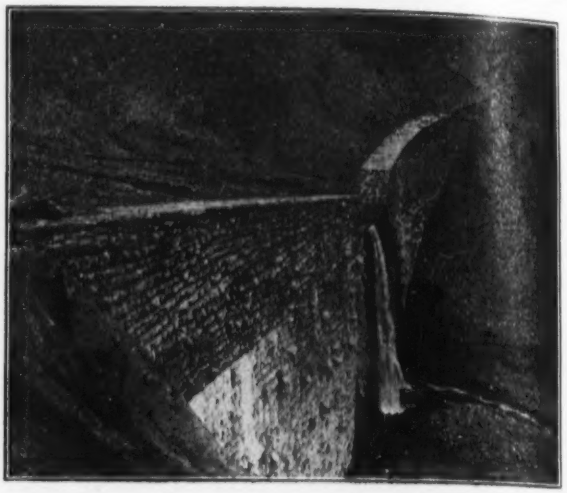


FIG. 2. A CLOSE-UP OF DAM 4

If one investigates the origin of such a mountain torrent, he finds that the stream coming from the high mountain levels has a tendency to cut deeper and deeper into the mountain bed and the power of erosion of the water is naturally most noticeable along the line of its greatest gradient, that is, in the upper part of the stream. It gradually loses this eroding action as the flow approaches the bottom of the valley, where the masses of water discharge into some other river or lake.

It has often happened that where this discharge takes place, the river, because of the great masses of detritus discharged into it by the creek, is deflected out of its original course and forced over towards the opposite shore. Not infrequently, in the region of the mouth of the mountain torrent, large sections of valuable ground have been destroyed by deposits of detritus or converted into a morass as a result of frequent inundations and, in any event, made permanently unsuitable for agricultural purposes. The dangerous and harmful results produced in neighborhoods suitable for the origination of mountain torrents of the character described above, are intensified with the increase in the erosion produced by the stream in the mountain.

In order to prevent the material harm that can be done by this kind of stream, it is necessary *in proper time* to take precautions that would counteract the causes creating the mountain torrents, which means, it is necessary to suitably harness the streams. Bearing in mind the way in which the mountain torrents originate, it is obvious that works to get them under control should be started, not in the lower part of the stream, that is, in the region where the creek discharges into some river or lake, but in the upper part of the stream which is the source of the evil. It is there, where the gradient of the fall is at its maximum, that the creek has a tendency to cut deep into the mountain, and the transport of detritus is at its maximum. In order to prevent the former as much as possible and to reduce the latter to a minimum, dams are constructed in the bed of the creek across its flow. Such dams are nothing but

stationary weirs. In contradistinction to the use of weirs in rivers to raise the level of the water, here they are built to keep back the masses of detritus and to give back once more to the slopes of the valley on both shores of the creek a firm hold on themselves. From this it follows that the construction of the dams not only artificially reduces the gradient of the creek but also tends

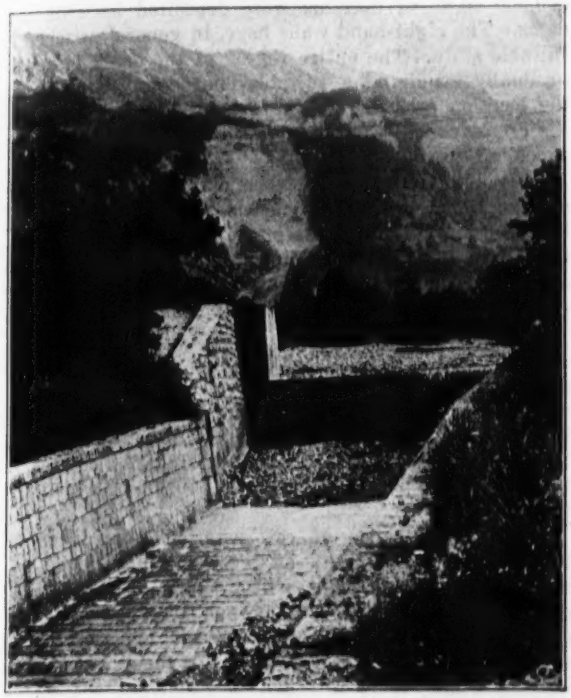


FIG. 3. MASONRY LINING OF A CONTROLLED CHANNEL

to restore the disturbed state of equilibrium in the entire region through which the creek flows.

But this is only the means to an end and not the end itself. It is only after a little while, subsequent to a successful harnessing of the creek, and after a certain permanent state around the creek has been established, that one can proceed with the last and most important stage of the work which alone can make the harnessing secure; that is the reforestation of the bare slopes. If this is carried out successfully, then the harnessing of the torrent may be considered as completed and for the future the creek may be left alone without particular apprehension.

To illustrate such work it will be useful to describe an interesting case of this kind of work recently carried out in Switzerland, namely, the harnessing of Lammbach Creek near Brienz. This creek has a long history of misdeeds back of it. Already in 1499, it overwhelmed the large village of Kienholtz and the Castle Kien by a wave, ten meters high, carrying with it masses of stone and earth. For many years thereafter, only a few miserable huts stood in the place of a once wealthy community. An impetus towards an effort to a thorough harnessing of this dangerous torrent was given, however, by the catastrophe of the year 1896. In the end of May in that year, large sections of the overhanging shores in the upper part of the creek collapsed, and the next September, after a period of prolonged rains, a threatening state of affairs was found to exist. With a noise like thunder, large sections of the shore fell in the upper part of the creek, dammed the flow of its water and forced the current to one side until it succeeded in carrying into the valley large amounts of detritus in one tremendous wave.

Previously, in 1872 to 1874, a large protecting dam had been built at the outlet from the valley but it was twice, shortly after its construction, carried away by the rising stream. In the meantime, the creek cut into its former bed to a considerable depth and as a result of this there was created in the immediate proximity of the valley, a fairly deep eroded ditch with steep crumbling walls on both sides.

The drainage area of the creek comprises 4.3 sq.km. From a geological point of view, the section of the mountains lying within this area consists of layers of lower chalk formation. The surface of these layers is often crossed by faults which facilitate tremendously the loosening of rock. Out of the detritus, as one can see from Fig. 1, upstanding rocks of harder formation stick out.

The following leading ideas were made the foundation of the plans worked out for harnessing the creek: In the first place, it was decided to build high dams in the collecting canal at the place where hard bald rocks came

FIG. 4. LOOKING DOWN OVER SOME STONE TERRACES

out of the ground, the purpose of this being to raise to the original level the bottom of the creek and to give a firm hold to the valley slopes on both sides.

Next, it was decided to put a definite end to the deposition of detritus masses at the so-called Blue Egg and to reinforce the steep section below that range by channel lining.

After the barrages across the creek had been completed, it was intended to put in intermediary dams in order to reduce still more the excessive head of the creek. Finally, it was decided to try to raise the bed of the creek still more in its lowest section by means of so-called Schindler piles in order to force, by these means, as great as possible a deposit of detritus. On the other hand, the amount of detritus brought in was to be reduced by proper harnessing of the lateral streams running into the main creek.

In the lowest part of the creek, a further large loca-

tion for the deposit of detritus was to be created and in order to protect the land in the neighborhood of the creek from further danger of being overrun by the waters, the place selected for the deposit of the detritus was to be kept within proper limits by a strong dam. In order to close off finally this location, a strongly built channel lining going as far as the Lake of Brienz was provided, this lining being built in the way shown in Fig. 3.

After a number of opinions had been obtained from prominent experts, the construction works were started and carried on in such a manner that already in the spring of 1897, the first large barrage constituting the foundation of the whole system of harnessing the creek was ready. The next job was that of protecting the location into which the deposit of detritus was to take place, with a massive dam, the purpose of which was to protect, during the period of construction, the inhabitants of Kienholz village, as well as the public road and the railroad. This being done, work was started on the next high barrage, this time at the so-called Blue Egg boulder.

In order to make the filling behind the dam as dry as possible a drainage system was provided and over it stone was packed. In this way a constant means of efflux of seepage water was secured until it became possible to pass the water from one dam to the other. This dam at Blue Egg is 90 m. wide and 19 m. high and is shown in Fig. 1.

After its completion, a start was made in 1898 on the barrage at Engi. Between these dams, tests were made with belts of piles which were, however, entirely destroyed as a result of a violent torrent in the course of which 172,000 cu.m. of detritus were hurled into the valley.

The essential difference between these two kinds of structures, namely, the massive barrage and the pile belt, lies in the fact that in the first case, the fall of the brook is broken while in the second case where the construction is not of massive character, it is intended to break the force of the water by sub-dividing the stream, which is to be attained by a series of belts of piles.

In 1904, Dam 4, shown in Fig. 2, was raised. In the following years a number of other dams shown in Fig. 1 (looking from the Blue Egg) were carried out and also the public road and railroad bed were raised (these were lying crosswise towards the lake at the foot of the spoil mound).

Fig. 3 shows the beginning of the channel lining leading directly from the location of detritus deposit towards the Lake of Brienz; this lining is somewhat over 200 m. long and has a slope at the bottom of 5.71 per cent. The entire construction in all its material parts was practically completed by the time the Great War began. The great extent of the work connected with this enterprise may be among other things judged from the fact that the cost of harnessing Lammbach Creek up to the end of 1913 was not less than 1,122,700 fr. of which 670,415 fr. was the cost of the twenty sections of channel lining erected in the course of the construction.

According to the figures kindly placed at the disposal of the author by the Federal Chief Inspection Service, a cubical content of the wall construction of all the dams amounted to 33,000 cu.m. to which should be added 2,000 m. of stonework for the dams in the drainage area and in the lower part of the creek.

The dimensions of the most important dams are:

	Upper Width	Height	Stonework
Dam 1	74 m.	13 m.	3,655 cu.m.
" 2	41 m.	16 m.	2,525 " "
" 3	60 m.	28 m.	5,600 " "
" 4	90 m.	19 m.	3,400 " "
" 4A	90 m.	19 m.	6,000 " "

So far, the results of the work of harnessing the creek have been satisfactory. Up to the end of 1914, already 500,000 cu.m. of detritus were deposited back of the dams. The right-hand walls have, in general, reached a suitable state. The entire region of the creek is again gradually acquiring a suitable character. Finally, at the location selected for the deposition of detritus by the creek, considerable amounts of material have been deposited.

It is now time to crown the excellent result of the constructional work in harnessing a mountain torrent by reforestation and grass planting of the bare slopes. Of course, reforestation and grass planting can begin only after the creek attains a state of more or less permanent equilibrium and the slopes on both sides have secured a reliable foothold.

Up to the time of the completion of the structural operations, less than 5 per cent of the entire encatchment area of the creek was covered with forest. The productive area under consideration amounted to 132 hectares. The lower section comprising 72 hectares is to be improved with 670,000 trees, 600,000 of which are to be alders.

In the upper zone of reforestation comprising 62 hectares, there is still an ever-present danger of avalanches. An attempt will be made to meet this danger by constructing numerous terraces of earth and stone as there is no wood for pile construction or material available for cut-stone masonry, generally. On the whole, it is intended to construct a total of 84,000 m. of earth terraces, 1 m. wide and in addition to this, 17,000 m. of stone terraces. The reforestation of this upper region, which has not yet been carried out, will comprise the planting of about 450,000 trees of which there will be 90,000 alders, 100,000 Siberian stone pines, 40,000 larches and 60,000 fir trees of two kinds.

Louisiana's New Vehicle Fees

Effective Jan. 1, 1922, a new schedule of license fees for passenger automobiles and motor trucks has been issued by the Secretary of State. Passenger automobiles are taxed on the basis of 68c. per horsepower, with a minimum fee of $15. The fees for motor trucks are as follows:

Capacity, Pounds		
750 to 4,000	per thousand	$10.00 plus 68c. per hp.
4,001 to 5,000	per thousand	12.50 plus 68c. per hp.
5,001 to 6,000	per thousand	15.00 plus 68c. per hp.
6,001 to 8,000	per thousand	20.00 plus 68c. per hp.
8,001 to 10,000	per thousand	25.00 plus 68c. per hp.
Over 10,000	per thousand	150.00 plus 68c. per hp.
Minimum		25.00

$10 per thousand pounds capacity for those used exclusively in cities of over 10,000 inhabitants.

Vehicles for passenger hire are required to pay 68c. per horsepower plus $2 per passenger for capacities of from 1 to 7 passengers; $3 per passenger for capacities of 8 to 25 passengers; and $5 per passenger for capacities of 25 passengers or more. A minimum fee of $25 is specified for vehicles operated for hire. Animal-drawn vehicles are taxed 25c. per 100 lb. of rated capacity.

Six Construction Mistakes in One Concrete Road

Ten-Inch Slab Too Thin for War Traffic—Dowels at Expansion Joints—Washout Shows Strength of Slab

By George L. Smith
Newport News, Va.

EXPERIENCE in building a 20-ft. concrete military road three years ago disclosed a number of errors which carry lessons. Early in the first year of the world war, the general in command of the port of embarkation at Newport News, Va., warned the city council that the army motor and other traffic which the streets of the city would be called upon to sustain would probably ruin all of the hard-surfaced pavements then existing, unless a special route were laid out and paved from Camp Stuart on the south to Camp Hill on the

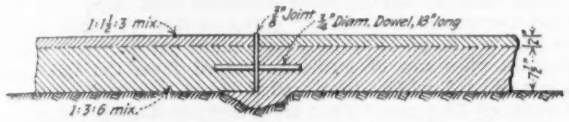


FIG. 1. DOWELED EXPANSION JOINT WITH THICKENING RIB

north of the city. This warning, together with the offer of certain citizens and the banks to finance the building of the special road, led to the appropriation of $100,000 for the construction of a "military highway" a little over three miles long.

A 10-in. concrete pavement 20 ft. wide was decided upon. It was also decided, in deference to the wishes of the city engineers, to make a flat sub-grade and to crown the concrete 2½ in. This gave a relatively thin edge—too thin, because lack of money prevented the building of water-bound macadam shoulders, even at street intersections. The thickness worked out, then, 10 in. at the center and 7½ in. at the edges. This was mistake No. 1.

Owing to the necessity for quick action, it was decided, with some misgivings, to let the contract on a cost-plus basis, the contractor to receive a total of 15 per cent over the cost of direct labor and material, the percentage to cover plant rentals, overhead and profit. The percentage was reasonable, but—this was mistake

FIG. 2. METHOD OF FORMING EXPANSION JOINT

No. 2—the city got neither an early completion of the work nor the benefit of highly efficient supervision, and the cost was excessive. Under the conditions, the contractor was not to blame. The city did the last third of the job at a considerably less unit cost and in quicker time, although wages were then over 5c. an hour more.

As the result of much pressure, the thickness of the pavement was cut down ½ in. leaving it 9½ in. at the center and 7 in. at the edges. This was mistake No. 3, because the thickness was needed, both for strength and for mass to resist shock.

The design contemplated the installation of expansion joints at 25-ft. intervals, with ⅜ in. of solid, asphalt-impregnated felt between blocks and four ¾ in. steel

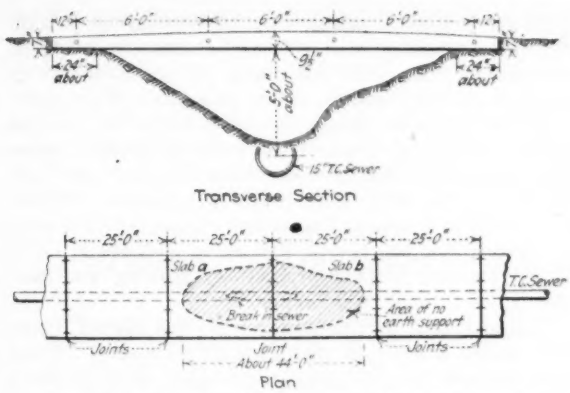


FIG. 3. DETAILS OF WASHOUT LEAVING SLAB UNSUPPORTED

dowels set half-way into the ends of adjacent blocks and passing through the joint material, as shown by Fig. 1. The idea was that a wheel, in passing from one block to another would have part of its load transmitted, through the shear in the dowels, to the block which it was approaching, before the tire actually passed the joint. Cantilever action, leading to excessive compression of the sub-grade at the joints under heavy loads and consequent cracking, would thus be avoided. Experience has borne out this theory fairly well; but we should have had eight dowels (we now use eight)—the small number of dowels was mistake No. 4.

The specifications called for the blocks to be installed alternately, both in order to avoid (or at least to remedy) honeycombing of the ends of the blocks at the joints and in order to provide for the joint material a solid bottom on which to rest, as shown by Fig. 1. This resulted in delay and some cost in moving the machine. Moreover, the blocks on the second pouring settled and shrank below the first ones, when struck level in finishing, thus making a slight hump or step at each joint. This was mistake No. 5, which was afterward remedied by measuring the shrinkage and altering the strike-board or joint screed. The shrinkage was not a constant amount, measured from a line parallel to the axis of the road, but was a maximum about 9 in. from the joint and a minimum at the joint—due probably to the thorough spading at the joint.

In order that the expansion joint might continue to protect the edges of the blocks, the material was cut off ¼ in. above the surface of the concrete by means of a sharp shovel with ¼ in. gage blocks secured to the under side. This worked very well. To prevent the joint material from being hammered down into the earth (the resistance of the dowels to this is very small), a scab or toe was provided by digging under the transverse forms before pouring, as shown by Fig. 2, and letting the concrete run beneath the form, care being taken to keep the top of this scab low enough to permit the removal of the form without loosening the dowels. In hot weather, the joint material is squeezed up and traffic irons it out so that it sticks only a little above the concrete. As cold weather comes on, traffic drives the joint material back into the recess. It has done this for four seasons, with the aid of a little hot bituminous material lately, and no joints are worn seriously, except some longitudinal ones alongside of car tracks which have not received proper attention.

These joints and this road have withstood the as-

saults of overloaded seven-ton trucks traveling at high speed, and provided with anti-skid chains consisting of one turn of ⅝ in. close-link chain. There is a terrific jar from such a truck for every revolution of the driving wheels, and the loose chain acts like a flail on the surface. Some of the first work put in cracked somewhat irregularly but not seriously; it was put into commission too soon after pouring. Another section was poured with slag in the bottom course, which floated up through the top course and made soft spots. The use of this slag without preliminary soaking was mistake No. 6.

Soon after one portion of the road was opened, there were hauled over it several 24-ton field pieces. These were mounted on two wheels, provided with diagonal cleats secured by snap-head rivets; so that, as the wheels turned, the entire weight came for a short period entirely on one rivet head in each wheel. Twelve tons on a rivet head gives a very high compressive stress, and this road surface bears today the imprints of the rivet heads, which compress the concrete in the same way as wood would be compressed and with practically no spalling.

A little later there was a stoppage in a main sewer running longitudinally beneath the center of the pavement. The stoppage became known through the overflowing of a manhole. Rodding showed a long plug of earth in the sewer in the middle of a block. To remedy the trouble it was necessary to make an exploration hole in the concrete, which revealed the condition shown by Fig. 3. Nobody could form any idea as to how long the sewer had been broken, because there had been no noticeable disturbance of the joint between blocks *a* and *b* and nobody could be found who had heard a hollow sound as the heavy trucks passed this point. Blocks *a* and *b* were at once broken up, the sewer repaired and, after a proper period had elapsed for settlement, the slabs were replaced. Undoubtedly the doweling of this joint was responsible for the maintenance in alignment of the blocks and, probably, for the avoidance of a serious accident.

Although built under very trying conditions (it will be recalled that the winter of 1917-18 was very severe) and although subject to the most extraordinary use and abuse, this piece of road which forms part of the national highway from Old Point Comfort to Washington via Richmond (and also part of the road from Old Point Comfort to Washington via Yorktown and Fredericksburg), is still in excellent condition and has many more years of life. The cost of maintenance has been very low.

First Brick Paved Street in U. S.

Charleston, W. Va., was the first city in the United States to use brick for street paving. Although brick had been used to pave streets in European countries, principally Holland, for nearly a century, they were not tried in the United States until 1871, when Charleston paved Summers St. with building brick, which served for 38 years. The state museum at Charleston has on exhibition the first brick laid in the street, from which not more than 1 in. was worn in the generation it served. In 1894 Quarrier St. was paved with brick and, although 27 years old, is still in good condition today. The brick were laid on a base of 3 in. of sand, 1 in. of tarred oak planks and a second 3-in. layer of sand.

Careful Handling Required in Placing Creosoted Piles

San Francisco Bay Study Shows That Treated Layer Must Not Be Broken Where Marine Borers Exist

AFTER the discovery a little over a year ago that the limnoria and teredo, marine borers hitherto absent from San Francisco Bay, were causing tremendous damage to wood structures in various parts of the bay, the San Francisco Bay Marine Piling Committee was organized to study the situation. Its second report, presented at the recent meeting of the American Wood Preservers Association, contains much recent information regarding the inroads made by the borers on harbor structures, and discusses especially the necessity for preserving intact the surface of all creosoted piles. This section of the report is as follows:

The data so far in hand indicates that it is fair to expect creosoted Douglas fir piling in San Francisco Bay to give a life of 15 to 20 years under present conditions. Certain piles are of authentic record from the Oakland Long Wharf which were sound when removed after a service of 29 years. Poor treatment, or damage to creosoted piling by careless handling, rafting, storage or construction, will materially reduce the life which might otherwise be rendered by such piling.

Copper sheathed piles have given very satisfactory service in locations where damage from abrasion and theft can be minimized. Such piles carefully prepared and handled fall into the class of best surface protections, when used under the conditions indicated.

Handling Piles Properly

The wharf construction sub-committee formulated specifications for handling on which it claims too much emphasis cannot be placed since so great a proportion are subjected to attack by marine borers on account of physical damage to the protective shell. The extent of the damage is likely to be in direct relation to the extent to which it is necessary to handle the piles.

The dog is by far the worst enemy of creosoted piling. The use of dogs should be unconditionally prohibited, except within specified distances of either end which will allow ample margin to protect the water section of the pile. When creosoted piles are prepared for towing considerable distance boring and reeving should be the only method of fastening allowed. The ax, the pike and the peavie also cause much damage. The holes left by sinking an ax in the piling, as is frequently done in handling, are much like those caused by the dog and are particularly dangerous. The use of pike poles and peavies should only be permitted when their points are blunted. The use of boat hooks during inspections by row boat or raft is also a source of considerable damage to treated piles in place and should be prohibited.

One of the most important duties of the pile-driving crew is to drive the piles without puncturing the protective shell. There is always danger of checking the piling under the hammer. In using a steam hammer it is well to use piles of a minimum butt diameter of 14 in. This permits the pile to be headed, trimming off all creosoted material so that the plate upon which the plunger strikes rests entirely on untreated wood and is not so likely to cause checking. On rocky bottoms, where there is little or no mud, great care must be taken not to split the pile. This can be done by avoiding hard driving and by the use of various types of steel shoes and plates.

Creosoted piling should not be cut off below high-water line, thus exposing untreated wood to attack by borers, if it can be avoided. Even side sloping where piling is cut near high water level, may permit limnoria attack, if water can settle where it does not run off. Furthermore, decay frequently occurs in the untreated interior of piles

when they are cut off at any level above high water. Whenever piles are cut off, therefore, the untreated wood should be protected by thoroughly painting the top of the cut-off portion with hot creosote. Above the water line, a further coating of thick asphalt may be applied to prevent the penetration of moisture; below water line the access of borers can be prevented by covering tightly with sheet copper.

The only safe way is to have all bracing, ribbing and other construction attachments well above high water. Where this cannot be done, dapping the piles, which exposes untreated wood, should be prohibited, except where it is absolutely unavoidable. Necessary cutting or framing should be done, so far as possible, on the pieces to be attached to the pile, since they are cheaper to renew. The braces, ribbing and other attachment members should be creosoted if they will be exposed to borer attack, and all boring and framing which can possibly be done in advance should be done before the members are creososted. Otherwise all such holes or framing cuttings should be well swabbed with hot creosote before putting the parts into the construction. All holes for bolts or pins should be bored not larger in diameter than the bolt or pin, to insure a driving fit. This will prevent borers from entering the bolt holes, so far as it is possible to provide against it.

Fender lines are always constructed of wooden piling, usually untreated in this region but sometimes treated. Connections to treated piling below the water line, where such connections expose untreated material, are dangerous. Bolt and spike holes provide a ready means for borers to enter. Where it is necessary to bore holes in creosoted fender piling the holes should be bored for a driving fit.

When a treated pile is damaged it should be immediately repaired. Holes should be plugged with creosoted material, and where repairs cannot be made in this way the damaged place should be covered with sheet copper. The Board of State Harbor Commissioners has recently been filling such holes, as well as those of the initial attacks of limnoria working in them, with cement mortar. It is too early to judge the effectiveness of the method, but it looks promising.

Portable Sectional Highway Piledriver with Swinging Leads

DEVELOPED for military road bridge building the piledriver shown by the accompanying view can easily be adapted to highway bridge building generally. It is assembled in sections which can be handled by a 3½-ton truck with a 6½ x 12-ft. box body. It will drive 40-ft. 15-in. piles in a 15-ft. bent, with a swing on the leads sufficient to drive the outside piles on a batter, and overreach enough to space the bents 15 ft. apart. Working tests with the first machine built developed the information that the machine could be assembled by untrained men in 15 working hours; that best results were secured with a steam hammer; that six trucks of the size stated would carry the whole outfit. With minor changes the piledriver is capable of rapid assembly and quick transport. It has the capacity to construct bridges that will take the heavier military loads and it is as light as safety and success of operation will permit. Using the normal five-pile batter bents 15 ft. wide it can accomplish its task with dispatch. The machine was built for the War Department by the McKiernan-Terry Drill Co., Dover, N. J.

AN ARMY PILEDRIVER

Ditch Riders, Their Qualifications and Duties

BY G. A. REMINGTON

General Manager, Nampa & Meridian Irrigation District, Idaho

Abstract of Paper Presented to Idaho Irrigation Congress, Jan. 20.

THE ditch rider, ditch walker, ditch tender, patrol man and zanzero are various titles or names used to describe the man who acts as the "go between" for the irrigation canal management and water user. He is the one who comes in daily contact with the man who carries the shovel. He must listen to all the things the irrigator has to offer in the shape of complaint, advice or criticism. He must sift out the portion to receive the attention of the water master or manager. On the job with arduous duties to perform by day, he is also subject to call by night to prevent or repair a break in the canal system.

A ditch rider should be courteous, accommodating and patient to those with whom he comes in daily contact. All canal companies or irrigation districts require these qualifications, the most important of which is to be patient and able to keep one's head under trying conditions. The user does not always stay cool and collected; he may air his opinions regarding the ditch rider and everyone in authority. It is much easier for the canal management to adjust difficulties if the ditch rider has not said too much.

The duties of each rider measured in irrigable area, the number of taps or miles of ditch varies so greatly on account of local conditions that it is impossible to set a hard and fast rule and say that a rider should make deliveries to so many acres, to so many taps or to travel a certain number of miles each day, in order to perform his full duty to the man who pays the water bill.

Under our project we patrol 153 miles of canal and laterals with ten riders, or an average of 15.3 miles on each ride, but the length each rides actually varies from 6 to 21½ miles. Still we think that the duties of each are so near alike that all get the same wage. Short rides are usually patrolled for protection, often two or more times during the day or night, while a longer ride is patrolled for the delivery of water only and the rider reaches a given point only once in 24 hours. Our district requires riders to patrol ditches 7 days of the week, while other work for the district is limited to 6 days.

Some companies or districts operating canal systems require the riders to keep a daily record of water deliveries. Such a record indicates the water delivered to each user each day and at the close of each month the record book is delivered to the secretary. We find that such a record is very valuable in cases of litigation and especially in cases of a claim for damages against us for non-delivery of water. This book contains the entire record of water called for and water delivered at each tap expressed in miners' inches.

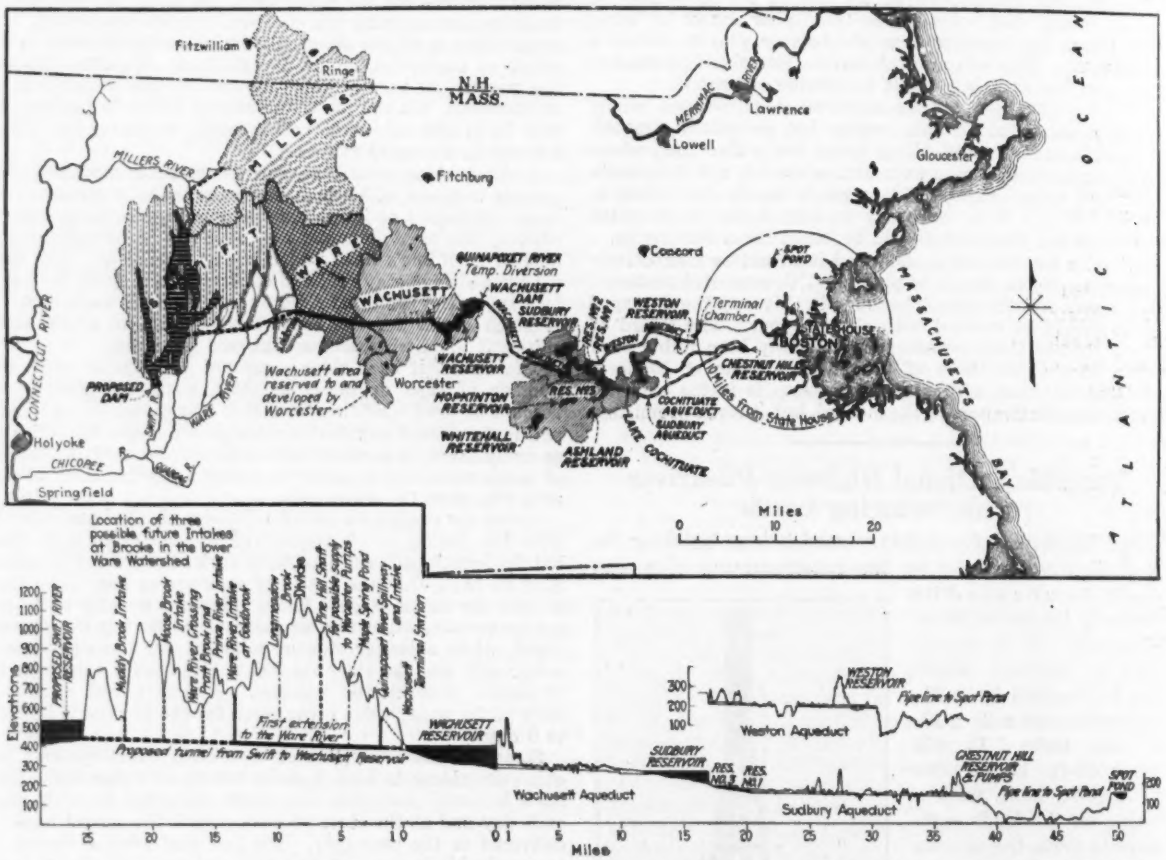
In the early days of irrigation in the Snake River valley, the supply of water was great and the acreage was small, which made it possible for a number of years to operate canals without locks, but as time went on the necessity for structures with locks became more and more apparent. Now with practically every irrigable acre receiving water, we find no canal operators undertaking the delivery of water without padlocks. This system is a protection to the district, as well as an insurance to the user that he will get his supply of water. After a user has had his gates locked for any length of time, he is satisfied with this method of delivering water, although we have been told that the early water users in our valley threatened that they would resort to litigation when the first locks were placed on their gates.

A $60,000,000 Addition to Boston District Water Supply

Store Run-Off Above 1.2 Sec.-Ft. Per Square Mile from Ware, Swift and Millers Rivers in Single 410 Billion Gallon Reservoir—500 M.G.D. Tunnel to Wachusett Reservoir—Yield 202 M.G.D.

IMMEDIATE construction of a tunnel to divert the flood flow of the Ware River to the Wachusett reservoir and thus provide an additional water supply of 33 m.g.d. for the Boston Metropolitan District and the city of Worcester is recommended by the Joint Board created by the Massachusetts Legislature of 1919 to report on the water-supply needs and resources of Massachusetts. The tunnel, which would carry 500 m.g.d. when extended to the Swift River, and the construction on that stream of a 410 billion gallon reservoir to store the flood flows of the Ware, Swift and Millers Rivers would together give a safe yield of 202 m.g.d.

The cost of obtaining 202 m.g.d. from the flood flows of the three rivers is estimated at $60,000,000, of which $12,000,000 is for the initial supply by tunnel from the Wachusett reservoir westerly to Coldbrook on the Ware River, including the diverting dam at that point. The tunnel to the 410 billion gallon reservoir on the Swift River to be formed by a dam at Enfield, and the other works necessary to obtain the full 202 m.g.d. yield from the Ware, Swift and Millers Rivers, is estimated to cost $48,000,000. The tunnel would have a capacity of 500 m.g.d. through its entire length since it is planned to convey flood flows for storage, and since the portion



MAP AND PROFILE OF PROPOSED ADDITIONAL WATER SUPPLY FOR METROPOLITAN WATER DISTRICT AND WORCESTER, MASSACHUSETTS

Besides basing the project on flood flows exceeding 1.2 sec.-ft. or about 775,000 gal. per day per square mile, the report is notable, considering its Massachusetts origin, for its recommendation that certain of the older portions of the existing water supply of the Metropolitan District, usually held in reserve because poorer in quality than the Nashua River supply, should be filtered "when needed." A minority report by one member of the Joint Board, advising further study of the Ware possibilities, including storage, before any land is taken or work done, is noted more fully at the close of this article.

between the Ware and the Swift rivers is designed to carry water in either direction, so that when the Wachusett reservoir is full the flood flow of the Ware may be sent westward for storage in the immense reservoir on the Swift River. The total length of the tunnel would be 25.1 miles, of which some 12 miles lies between the Wachusett reservoir and the Ware River. For purposes of estimating, the diameter of the tunnel is placed at 12¾ ft. It would be in deep rock. All the cost estimates are based on pre-war prices, plus 30 per cent, which is reasonable inasmuch as most of the construction would not be undertaken for some years.

In addition to the needs of the Metropolitan Water District, the report also considers (1) the water problems of several other sections of the State; (2) the possibilities of filtering Merrimack River water; (3) artesian wells; and (4) the wisdom of permitting some of the "Great Ponds" of the state to be used for boating, bathing and fishing instead of holding them so exclusively for water-supply as some of them are. The formation of three new water-supply districts is advised. Filtration of the Merrimack is not recommended because the stream (1) is so badly polluted and (2) is so much needed for power, while (3) a joint supply for several of the Merrimack Valley cities promises to be far better. Artesian and other wells are briefly dismissed as of no promise, except for small local supplies. The need of a freer use of the Great Ponds for recreation is recognized and such use is approved, but subject to purification of water drawn from them for domestic use, and with a recognition that public sentiment is against bathing in waters devoted to public supply, even though the waters be purified subsequently.

Antecedents and Personnel

The Joint Board, it may be noted in passing, is composed of the State Department of Health and the Metropolitan District Commission, the latter, through successive consolidations, now exercising the functions of the earlier (1) water, (2) sewerage and (3) park commissions. The Metropolitan Water and Sewerage Board constructed the existing works of the Metropolitan Water District in accordance with the 1895 report of the Massachusetts State Board of Health. The Joint Board was organized with Dr. Henry P. Walcott (then chairman of the Massachusetts Water & Sewerage Board) as chairman, X. H. Goodnough, chief engineer State Department of Health, secretary and engineer and F. P. Stearns as consulting engineer. Dr. Walcott soon resigned from the Water and Sewerage Board, but continued as adviser to the Joint Board. Dr. Eugene R. Kelley, state commissioner of health, has since been chairman of the Joint Board. Mr. Stearns died Dec. 1, 1919, and was succeeded as consulting engineer by J. Waldo Smith, chief engineer of the Board of Water Supply, New York City. Mr. Goodnough has been chief engineer of the investigations, with Bertram Brewer as principal assistant engineer. Professors W. O. Crosby and Charles P. Berkey have given advice on matters of geology; Harry W. Clark on filtration; Charles T. Main on water power; and Ralph A. Stewart on special legal phases of the problem.

The Metropolitan Water District now embraces 18 municipalities within ten miles of the State House that take their supply from common sources, and the city of Newton, which as yet depends chiefly on its own independent supply. There are 16 additional cities and towns within the ten-mile circle that now use local supplies but are entitled to join the district, and there are a considerable number of the towns that may yet wish to come in. The needs of the city of Worcester are also taken into account, for reasons given later.

The Joint Board's own summary of its recommendations follow:

1. Definite arrangements should at once be made for securing an additional supply of water from the Ware River for the joint use of the Metropolitan Water District and the City of Worcester.

2. A tunnel about 13 ft. in diameter and about 12 miles long should be constructed from the Wachusett reservoir westward to Coldbrook on the Ware River at an estimated cost of about $12,000,000.

3. This tunnel should be used to divert the flood flows of the Ware River to the Wachusett reservoir, securing an additional supply of water of about 33 m.g.d., in such a way as to interfere as little as possible with the mills on the lower Ware River.

4. Provision should be made for pumping water from this tunnel into a stream which flows to Pine Hill reservoir, now being constructed by the City of Worcester, or from the Wachusett reservoir into the Worcester distributing system, as may hereafter be determined.

5. The Swift River project, involving the construction of a great reservoir near Enfield and connecting it with the Wachusett reservoir by means of an extension of the tunnel to the Ware River, should be approved as the logical extension of the water supply system.

6. The construction work on the approved project should be progressively developed as required in order to insure at all times an adequate supply of water to the Metropolitan District and to Worcester.

7. Plans should be drawn for filtering the waters of the South Sudbury and Cochituate systems, now held as reserve supplies, keeping in mind the ultimate filtration of all of the Metropolitan water supply.

8. The South Sudbury and Cochituate filters should be constructed when needed.

9. Efforts to prevent leakage and waste of water should be continued in order to conserve the present supply to the greatest possible extent.

10. For the same reason the local supplies of the communities within the ten-mile radius and adjacent thereto should be developed to their economical limit, using filtration if necessary, but keeping in mind the possibility of their ultimate abandonment.

11. The construction of the proposed works should be entrusted to the Metropolitan District Commission or to a special commission, as the Legislature may determine.

12. A Southeastern Water District should be created to enable the cities of Fall River, New Bedford and Taunton, and such other cities and towns as may desire to do so, to develop the Assawompsett and adjacent ponds as a common source of water supply.

13. Consideration should be given to the advisability of organizing a similar water district in Essex County for the purpose of developing the Ipswich River by the construction of one or more large storage reservoirs for the joint use of the cities and towns in that part of the state.

14. Consideration should be given to the advisability of organizing still another water supply district in Hampden County for the purpose of developing the Westfield River for water supply purposes.

Conservation of Water Power

Considerable portions of the reports of both the Joint Board and Mr. Goodnough are devoted to the conservation of existing water powers. It is noted that even where fuel is substituted for water power and full compensation made, streams may be left in a "sorry condition" from the sanitary and other viewpoints and much damage done. To interfere as little as may be with water power and the useful flow of the streams to be taken for an additional supply, Mr. Goodnough worked out the plan for utilizing flood flows, the main features of which are the immense storage reservoir and the large tunnel already mentioned. This plan, the Joint Board believes, has merits that will win the co-operation of riparian owners. It expresses the opinion that "the mill owners want water, not money"; and that the "communities in the central part of the state should not be called upon to sacrifice their summer rivers for the benefit of the Metropolitan District when it is possible to utilize the spring flood waters which would otherwise

go to waste." The discussion of these and related phases of the subject is thus summarized by the Joint Board:

The following general principles should be considered as representing the Massachusetts policy for protecting the purity of her surface water supplies: (1) Choice of unpolluted sources as far as practicable; (2) utilization of the natural agencies of purification to the greatest practicable extent; (3) prevention of pollution by land purchase and by the enforcement of sanitary rules and regulations; (4) filtration of water (a) when the population on the watershed is relatively large, (b) when it is desired to permit boating and fishing in the sources of supply, (c) when the water is unsatisfactory in its appearance, taste, or odor; (5) the choice of filtration and other purification methods to be governed by the nature of the supply, by cost considerations, and by the desire to produce a water hygienically safe, attractive in its appearance, tasteless and odorless, and without corrosive properties; (6) the combination of these various natural and artificial protective methods according to local conditions and economical considerations; (7) the storage of filtered water in covered basins as far as this is practicable.

Mr. Goodnough's report presents in detail the yearly water consumption in the cities and towns of the present and prospective Metropolitan District and in other cities as well, and the per capita water consumption in the District and also in a number of other cities chosen for comparison. Mr. Goodnough states that, in all the cities studied, after from two-thirds to three-fourths of all the services had been metered, there was no case where an increasing consumption was checked by setting more meters. The Joint Board assumes that after the waste in the Metropolitan District has been cut to the minimum the consumption will continue to increase about 1 gal. per capita per year, which has been the average rate of increase in Boston since 1850. It notes that in many other cities, completely metered, the increase is 2 gal., but adds that Boston uses less water for manufacturing than most of the cities considered. One of Mr. Goodnough's tables shows that with 75.6 per cent of the taps metered the per capita water consumption in the Metropolitan Water District, including Newton, was 105.4 gal. in 1920, which was the lowest for any northern city in the United States east of the Rocky Mountains with a population in excess of 400,000. Mr. Goodnough estimates that by 1970 the Metropolitan District and Newton will have a population of 2,590,000 compared with the 1920 census count of 1,252,903; that the per capita water consumption will be 146.3 gal. and the total daily consumption 379 million gallons.

The total safe yield of the present sources of water supply of the Metropolitan Water District is placed at 154 m.g.d.; Newton, 4; Worcester, 19.3; total, 177.3 m.g.d. Looking ahead no further than 1935, and assuming that up to that time only the present district, Newton, Worcester and certain other municipalities whose local supplies could still be used to the extent of a yield of 22.8 m.g.d., would need to be provided for, the conditions in 1920 and each succeeding five years would be (in m.g.d.):

	1920	1925	1930	1935
Safe yield	200.1	200.1	200.1	199.1
Total need	172.1	192.5	222.9	254.6
Excess	28.0	7.6	.....	.....
Deficiency	.....	.....	22.8	55.5

The Ware River diversion, without storage, would give a safe yield of 33 m.g.d., and with the storage afforded by the Swift River reservoir, 47 m.g.d., from a drainage area of 100 sq. miles. The yield from 186 sq. miles of Swift River drainage area is placed at 87 m.g.d. Millers River could be diverted to the Swift River reservoir from an area of 220.5 sq. miles, giving 96 m.g.d. The total area of 506.5 sq. miles would yield altogether, it is estimated, 230 m.g.d. or, allowing for various losses, 202 m.g.d. net. All these yields are based on using only high flows, generally occurring in the winter and spring, in excess of 1.2 sec.-ft. per sq. mile, and without interference with the normal flows of the three streams. It is recommended by Mr. Goodnough that the Swift River reservoir be put under construction soon enough to begin filling in by 1934.

At this point it may be explained that one reason for including Worcester in the proposed additional supply for the Metropolitan District is that the city already has rights from the Legislature and has already diverted a part of the watershed tributary to the Wachusett reservoir. The city has petitioned the Legislature for the right to a further supply from the Wachusett watershed and if this water is diverted to Worcester the Metropolitan supply would be still further diminished. It would be better for all concerned, the Joint Board believes, for Worcester to join with the Metropolitan District in an extension of the Metropolitan works to the Ware River, and then take water either from the tunnel to the Ware River or from the Wachusett Reservoir.

The cost of the entire project, as estimated by Mr. Goodnough, is summarized in the accompanying table.

The Swift River reservoir would be formed by an earth dam at Enfield 165 ft. high above the present surface of the river and 271 ft. above rock at lowest point, and a dike across Beaver Brook 133 ft. high above the natural water surface and 268 ft. above rock. Both the dam and the dike would have their tops 18 ft. above the flow line, and slopes "somewhat flatter" than 3 to 1 for the upstream and 2.5 to 1 for the downstream faces. The dam and dike would have impervious cores to bedrock. The reservoir would have a water surface of 39 sq. miles; maximum water depth, 150 ft.; average depth, 51 ft. The length of railways flooded would be 15.9 miles and of highways, 106 miles. The number of buildings flooded by the reservoir would be 1,040 of which 463 are occupied houses and 30 vacant houses and 61 camps and summer cottages. As to the preparation of the reservoir site, Mr. Goodnough states that it "should be cleared of bushes and trees and all organic matter destroyed so far as practicable," but soil stripping "would be impracticable on

SUMMARY OF COST ESTIMATES, ADDITIONAL WATER SUPPLY FOR METROPOLITAN WATER DISTRICT AND WORCESTER, MASS.

	Construction Cost and Overhead, Pre-war Basis		Probable Cost in 1924-1935, Pre-war + 30%
Main Dam at West Ware Station:			
Main embankment	$7,124,000		
Diversion tunnel and control works	1,201,900		
Spillway and flood channel	251,700		
		$8,577,600	$11,150,880
Beaver Brook Dike:			
Main embankment	6,529,000		
West dike	85,000		
		6,614,000	8,598,200
Main Storage Reservoir in Swift Valley:			
Clearing, grubbing and fencing; Relocation and reconstruction of highways, 47 miles; Relocation of R. R., 21½ miles; Relocation of cemeteries; Relocation of transmission lines; Sanitation and forestry		5,064,300	6,583,590
Eagleville Reservoir Diversion:			
Raising Eagleville dam	44,700		
New channel via Hacker Pond	108,400	153,100	199,030
Millers River Diversion:			
Diversion dam and intake	159,400		
Aqueduct to Eagleville Res.	1,173,500		
Gardner & Winchendon sewer	729,400		
		2,062,300	2,680,990
Aqueduct to Wachusett Reservoir:			
Tunnel and shafts	17,457,100		
Intakes to aqueduct	376,000		
Wachusett terminal	339,400		
		18,172,500	23,624,250
Total Construction		$40,643,800	$52,836,940
Real estate, rights of way, depreciation, business damage, diversion damages and water rights, mills and factories below the points of diversion			7,109,600
			$59,946,540

account of the excessive cost and is unnecessary in the existing circumstances."

In a minority report, James A. Bailey, chairman of the Metropolitan District Commission (which operates the present Metropolitan water system) agrees with the other members of the Joint Board as to the advisability of going to the Ware River but not as to its immediate urgency or as to its being certain that no storage should be provided on the Ware. He recommends that the Legislature make a moderate appropriation for further studies of the Ware, but that it authorize no taking of lands or construction of works at this session. He thinks that the Metropolitan Water District, together with any likely enlargement meanwhile, will not "need additional water before 1935." He bases this on the possibility of checking the increase in consumption, and on the slow growth of the district.

New Type of Trunnion Bascule Bridge: Wabash Ry.

Link System in Abt Design Connects Machinery Girder Traveling on Incline with Movable Counterweight Pivoted to Bridge Side of Tower

A NEW type of trunnion bascule bridge has been built for the Wabash Ry. Co. crossing of the River Rouge near Detroit, and was put into service Jan. 26. The bascule span, shown by the views in Fig. 1, is 162 ft. long. It is flanked by a 73½-ft. span at one end to carry the counterweight tower and a 53-ft. approach span at the other end, the total length of the bridge being 291 ft. The new design is considered to be more economical than other types.

A contra-rotating counterweight mounted on the bridge side of the tower and a link system connecting this counterweight with the bascule leaf form the special features in the design. From the drawing, Fig. 2, it will be seen that the link system is composed of four members: (1) a rocking link pivoted to the trunnion and having its head connected to the hip joint at the top chord; (2) the tension member or link attached to the head of the rocker and through it connected to the top chord of the truss; (3) the compression link supporting the counterweight, and (4) the counterweight arm pivoted to the tower.

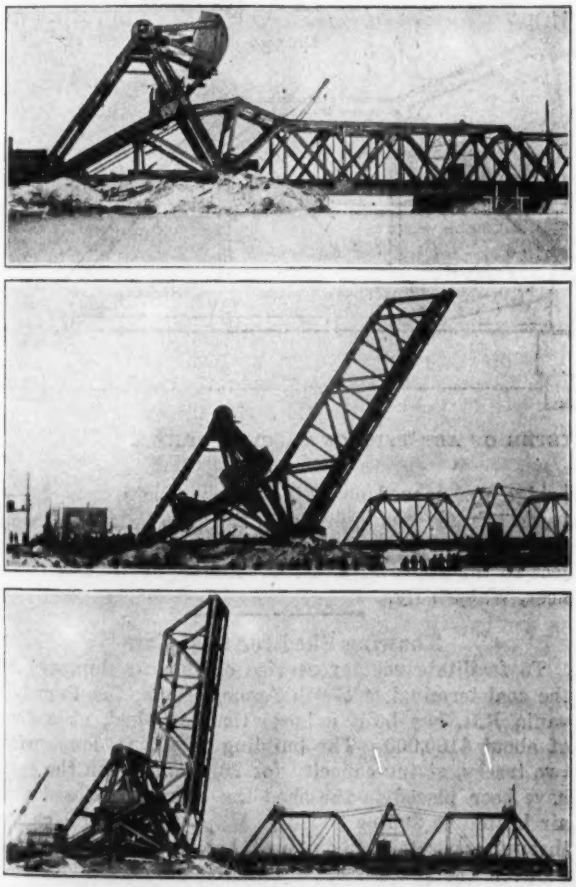


FIG. 1. WABASH RY. BASCULE BRIDGE OVER RIVER ROUGE, DETROIT

Top, bridge lowered; middle, bridge partly raised; bottom, bridge in full raised position.

The tension and compression links (2) and (3) are both pivoted to a heavy transverse girder which carries the machinery and which travels on inclined rails in the tower framing. Operating pinions on this girder engage with racks on the inclined path. As this girder is moved down the incline it raises the bridge. At the same time it allows the counterweight to swing downward and thus exert a thrust against the girder to counterbalance its pull on the leaf.

The counterweight is a steel basket filled with concrete. Since the bridge was erected in the open or vertical position the counterweight hung suspended from its bearings, which facilitated placing the concrete fill. The counterweight weighs about 1,000 tons. Adjustments of weight are effected by means of separate concrete blocks weighing 2,500 lb. each. The weight of the moving leaf approximates 400 tons. The main trunnions are 26 in. in diameter and 19 in. long.

Bascules of four different types and a vertical-lift span were considered in the preliminary designs for this bridge. The bascule designs were as follows: (1) A plan prepared by the engineering department of the Wabash Ry., having a counterweight attached rigidly to the leaf; (2) a Strauss bascule bridge; (3) a design originated by C. G. E. Larsson, of the American Bridge Co., New York, which required no counterweight and was to be operated by combined pneumatic and hydraulic machinery; (4) a bridge similar to the type patented by Elmore D. Cummings, St. Paul, Minn. It is understood that no bridges of the last two types have been built, and the Cummings patent (Dec. 31, 1901) has now expired.

This fourth design as submitted originally by the American Bridge Co. included features which were similar to those of the Cummings patent, although that patent was not known to the representatives of the company until later. Mr. Cunningham, chief engineer of the Wabash Ry., informed the company that a model of a similar design had been submitted to him when he built his first bascule bridge, but that he objected to it on account of the flexible connection (chain or cable) of the counterweight to the bridge. After a thorough study of this type of bridge the American Bridge Co. modified its design by using two links for connecting

the counterweight to the trusses, which design was submitted to Mr. Cunningham and approved by him. This new design, which has been patented, was prepared by Hugo Abt, of the company's designing department, under the direction of Albert Reichmann, division engineer.

Two 100-hp. electric motors are installed in the machinery house located on the traveling cross-girder. One of these is sufficient to operate the bridge; clutches are provided so that either motor can be used alone. For auxiliary power there is a 58-hp. gasoline engine. One motor can open or close the bridge in less than 1½ minutes, but with the gas engine the time is about 8 minutes. Each motor has a solenoid brake for full torque, that is, for holding the leaf in any position. One of these brakes has an attachment for converting it into a hand brake when the gasoline engine is to be used. On the motor shaft is an air brake designed for the full torque of the two motors.

Two emergency brakes, entirely independent of the operating machinery, grip I-beams laid along the inclined track girders of the tower. Each of these can develop a holding power of 88 tons. These grip brakes are operated by compressed air, the supply being independent of that to the air brake on the motor shaft. All brakes are arranged to set slowly and release quickly. A compressor with a capacity of 25 cu.ft. of free air per minute keeps the receiver pressure automatically at 100 lb.

The bridge is operated from the second floor of the operator's cabin on the approach, on which floor is also installed the interlocking machine for the railway signals. Electrical interlocking of the bridge mechanism with the track connections and signals is so arranged that the bridge cannot be operated until the signals have been set properly and that the several operations must be performed in regular sequence.

The bridge is designed for E 50 loading on each track. It is dimensioned according to the specifications of the American Railway Engineering Association, and its machinery according to that association's proposed specifications for movable railway bridges.

Fabrication was done at the Gary plant of the American Bridge Co. Erection was in charge of James L. DeVou, division erecting manager of the same company. Electrical, air and gasoline equipment was furnished and installed by the Norwood-Noonan Co., Chicago. Signal and interlocking plant was provided by the Union Switch & Signal Co. The substructure was built by the J. W. McMurry Contracting Co., of Kansas City, Mo. To avoid interference with traffic, the bridge was erected in the vertical or open position at one end of the old swing bridge, which continued in use until the new structure was practically completed. Then the old bridge was moved out laterally on rollers upon falsework. Traffic was interrupted for only 7½ hours during this change. All design and construction work was subject to the approval of A. O. Cunningham, chief engineer, Wabash Ry.

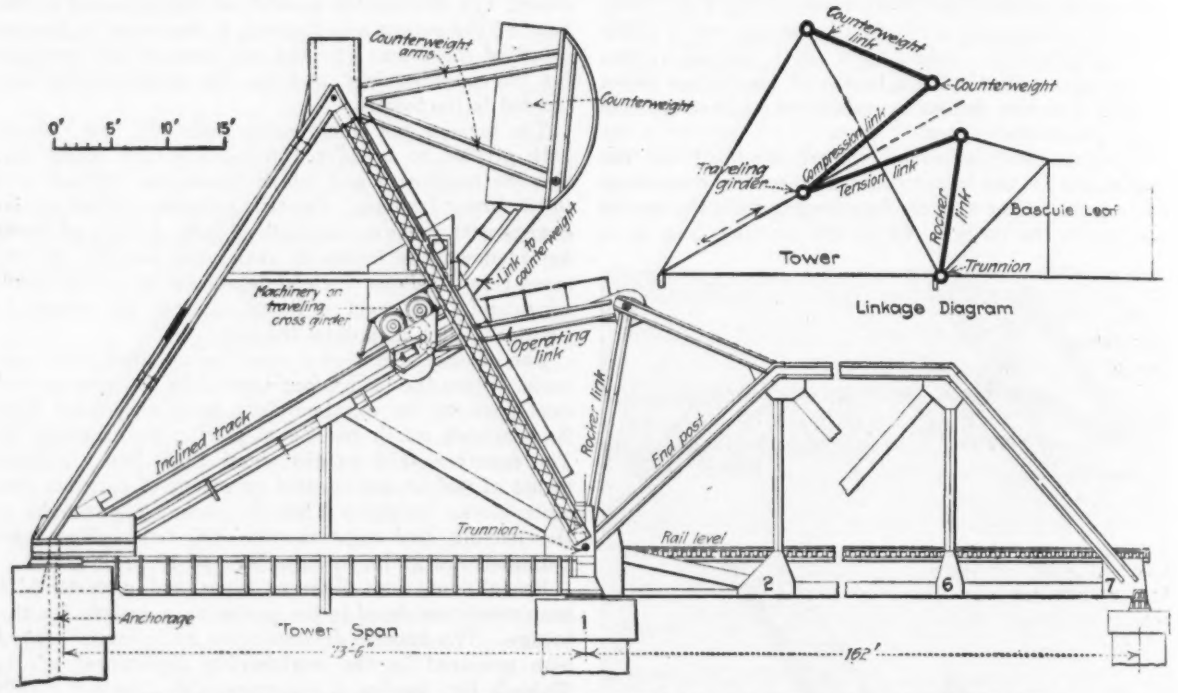


FIG. 2. OPERATING AND COUNTERWEIGHT SYSTEM OF ABT TYPE OF BASCULE BRIDGE

Thawing Shed for Coal Cars

To facilitate regular service of the car dumpers of the coal terminal at South Amboy, N. J., the Pennsylvania R.R. has built a large thawing shed, at a cost of about $100,000. The building is 448 ft. long, with two tracks, giving capacity for 20 cars. When the cars have been placed in the shed the doors are closed and air heated to 200 or 250 deg. F., is forced by blowers through concrete-floor ducts having openings 6 ft. apart between the track rails. Three hours is an average time for thawing, but the actual time varies from one to twelve hours, depending upon the weather and the condition of the coal. From the shed the cars are moved by gravity to the car-dumping machines.

Against Maintenance Guarantees for Roads and Pavements

They Prove Unfair to Contractors, Uneconomical to Owners, and Frequently Limit the Number of Bidders

By Edward W. Bush

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MAINTENANCE guarantees in road and pavement contracts are generally so drastic in form and so unfair to the contractor that, instead of benefiting the owner, they actually force him to pay more than he should for the work. No one can tell what kind of traffic a road will be called upon to bear three or four years hence. A. Dryland, county engineer of Middlesex, England, states in an article in *Engineering News-Record*, Dec. 1, 1921, p. 892, that our troubles from heavy vehicles are just beginning, judging by the English experience. These are risks that the owners should assume, because their engineers specify how the road is to be built and supervise its construction. It seems manifestly unfair to ask contractors to guarantee to owners that their engineers know their business. The fair way would be to ask contractors to bid on supplying materials that will pass specifications and construct the work in the manner specified. When they have done this, the job should be considered completed and the contractor's liability terminated. To ask for anything more is unfair and uneconomic. The day is past when any state or city can get something in the paving line for nothing.

Good roads are expensive and because every locality wants good roads there is a constant tendency to stretch available funds out too thin and try to cover more area or mileage than is possible and still produce a road that will stand up well under traffic. This is a matter that engineers cannot always control and no doubt many of them try to do the best they can under the circumstances, but they can always tell the owners that the final results may be disappointments. Many localities seek to safeguard their large expenditures for roads by incorporating a stiff maintenance guarantee in their contracts and thus pass the buck along to the contractors.

No Uniformity in Guarantees

The author has reviewed a large number of road and pavements contracts from every part of the United States that have included maintenance guarantees of all sorts. No general uniformity of specifying the guarantee exists, and one is never sure as to what the guarantee covers until the contract, specifications and bond have been closely read and a guess made as to what the engineer really intends or how he will interpret the language set forth in the documents. Some contracts may, in one clause, clearly limit the guarantee to defects of workmanship and materials while under another clause of the same contract the guarantee is restated in so broad a manner that the contractor is liable for about anything that can happen to the pavement irrespective of whether or not his materials or workmanship contributed in any way to the defect or repairs.

The author was rash enough at one time to believe he could classify the different kinds of maintenance guarantees on roads and pavements, but soon gave it up as an impossible task and was only able to make three broad divisions as follows:

A. Guarantee against defects in workmanship and materials.

B. Guarantee against defects in workmanship and materials and defects arising from the use of the surface as a roadway.

C. Guarantee to make all repairs and maintain the pavement in perfect condition, irrespective of the causes that produce the defects, or, by specifically excluding certain causes, leave the guarantee active on defects arising from all other causes.

If the contractor has carefully performed the work, has been particular in obtaining the inspector's approval of all materials and workmanship and has kept a good record of these things, it will probably be difficult for the owners to recover under guarantee A, unless the contractor prefers to make the repairs rather than dispute the claim. In the absence of fraud on the part of the contractor, it is difficult to conceive of any just claim being made during the guarantee period if the work was carefully supervised by the engineer during the construction period. In fact, the engineer certifies in the final estimate that the work has been performed and completed in accordance with the terms of the contract. As long as politicians are placed in authority over the expenditure of public funds we will see newly appointed commissions trying to discredit the acts of their predecessors and extravagant claims may be made under paving guarantees.

Effects of Guarantees

Many reputable and experienced paving contractors do not object to taking contracts that include a simple maintenance guarantee (such as Class A), against defective workmanship and materials, because, having faith in their ability to fulfill the contract and specifications, they do not believe they will be called upon for any great amount of repairs. The maintenance guarantee is a liability, however, and the conservative contractor will set up a reserve against it and will charge accordingly in preparing his bid.

If engineers and commissioners feel that they must have a maintenance guarantee, it should be limited to defects arising from poor workmanship and materials, anything beyond this is unfair to the contractor.

The Class B guarantee is the same as Class A plus a guarantee that the road will not wear out under traffic. In other words, it is a guarantee to the owners that the engineers and inspectors employed by them know their business and the road designed by and constructed under them will remain in perfect condition during the guarantee period. If the engineers have used poor judgment or stretched the money too far, the contractor is obligated to repair any places that wear out under traffic, even to the extent of replacing the entire job.

The Class B guarantee is illogical unless the owners employ no engineers or inspectors to design and supervise, but leave the design as well as the entire construction wholly to the contractor and merely hold the latter responsible for building a road of a certain general type that will stand up under an unknown traffic during the term of the guarantee. There are innumerable road contractors who are entirely competent to undertake contracts on this basis, but in recent years the author has never happened to run across a road or pavement built with public funds that had such a form of contract.

All other kinds of maintenance guarantee, not included in Classes A and B, have been placed in a Class C, where there seems to be no uniformity in the terms but a general desire to have the contractor supply a maintenance service in addition to building a perfect road or pavement. Often it is difficult to reconcile the different clauses of the same contract and some contracts have been reviewed where it is believed the engineer wrote some of the clauses limiting the guarantee to certain things, and afterwards a lawyer added his clause drawn in such a way as to make the contractor liable to repair all defects, irrespective of the cause. Other contracts appear to have been assembled by taking a clause here and there from different sources and perhaps applying a guarantee taken from a sheet asphalt job to a one-course concrete pavement.

Unjust Requirements

Clauses have been seen that would make the contractor keep the pavement free of snow, ice or mud, provided the engineer ordered such maintenance under the clause. Some contracts exempt ordinary wear or use of the pavement, and others specifically state that just before the guarantee period expires a careful examination will be made and, if the pavement is not in perfect condition, the contractor will proceed to put it in perfect condition, no exemptions being included. A few contracts for concrete roads have been found recognizing that such roads may crack and providing for the cracks being filled with bituminous material, but very many other contracts have been written that ignore cracks and it is possible for maintenance claims to be made because of the cracks.

Trenches are constantly being opened in streets before and after pavements are laid and in many soils it is almost impossible to tamp the refilling so no depression will occur. Sometimes sewers break and great holes are washed out beneath the pavement. When a water main breaks the hydraulic pressure may force a large area of the pavement upwards. These and many other causes will produce an uneven surface, and it does not seem fair to ask the contractor to carry these risks. Still, contracts have been read that make the contractors carry the liability. Recently the author read a paving contract that specifically made the contractor responsible for five years for any depressions caused by any trenching done prior to the laying of the paving foundation. Also, it defined a depression as being any place that would hold water or was apparent by laying a straight edge along the surface.

Past experience has shown that the business of building roads and pavements is a precarious one. Uncertainties about the weather, the cost of transportation, ability to obtain labor, the cost of labor, and whether or not local materials can be used, enter into many contracts, with the result that the bonding companies have been called upon to pay large losses on road contracts. No one knows what contractors will be in business five years hence, and, because of this, sureties are disinclined to write maintenance bonds except for contractors who are well established and have a financial strength sufficiently great to permit them to overcome reasonable reverses in the business and still be a going concern during the maintenance period. Surety bonds are not written on an insurance basis; they are a form of credit. Whenever a maintenance guarantee is required it automatically limits the bidding to those who are able to obtain the maintenance bond, and many otherwise desirable contractors refrain from bidding.

A close study of this question of maintenance has convinced the author that all maintenance guarantees are decidedly unfair to the contractors and uneconomic to the owners. They should no longer be called for in road and paving contracts.

Reducing Bend as Venturi Meter in Hydro-Electric Plant

Penstock and Scroll Inlet Tapped Circumferentially —Connecting Encircling Pipe Leads to Recording Instrument

By E. A. Dow

Mechanical Engineer, New England Power Co., Worcester, Mass.

A FEATURE, which, in the case of the average hydro-electric plant, receives far less consideration than its importance justifies, is an adequate provision for water measurement. An accurate and continuous record of stream flow as a guide to efficient operation is of the utmost importance, and the value of an easy and simple method of checking turbine discharge, always available, which will enable the operating superintendent to determine turbine efficiencies at frequent intervals and thus know immediately when his wheels need attention, cannot be overestimated. Nevertheless, probably well over 90 per cent of the power plants in operation today are absolutely without any effective means of metering water, due partly to a failure to

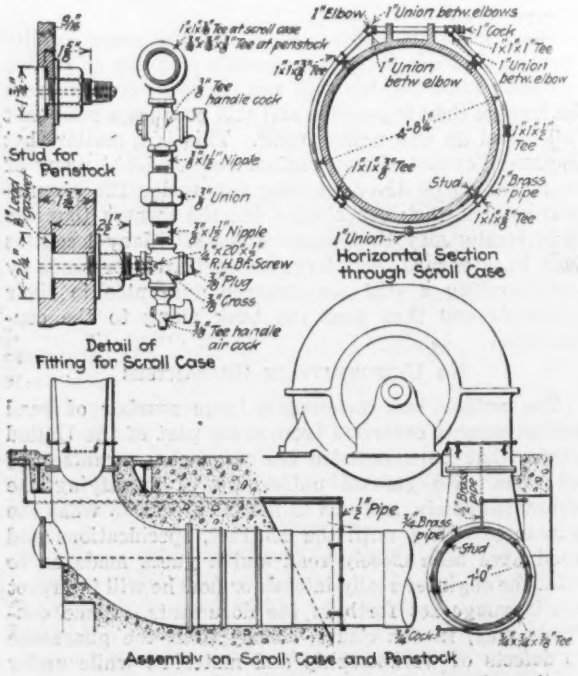

Stud for Penstock
Detail of Fitting for Scroll Case
Horizontal Section through Scroll Case
Assembly on Scroll Case and Penstock

FIG. 1. VENTURI METER PIPE FITTINGS ON PENSTOCK AND SCROLL CASE

appreciate the importance of the subject and partly to the fact that no meter really suited to power-plant requirements has ever been available. A modified venturi meter, having a throat larger, comparatively, than the standard, in order to eliminate the excessive head loss inherent in the older type, would be satis-

factory and should be considered for any new development having a pipe line or penstock, but such a meter is expensive and frequently impossible to install in a plant already in operation. For such a plant the problem is to find a satisfactory substitute. That this is sometimes possible at small cost and without the introduction of additional head losses, is evident from the results obtained recently at Plant 5 of the New England Power Company.

This plant is located on the Deerfield River, three miles above Hoosac Tunnel, Mass., and is equipped with three Allis-Chalmers 8,000-hp. turbines operating under a head of 240 ft. These turbines are of the horizontal type, having cast-iron scroll cases with inlet flanges horizontal. The water is brought to them through three steel penstocks about 590 ft. long, 7 ft. in diameter for the greater part of their length, but tapering to 6½ ft. at the lower ends. The connection between the vertical flange faces of the lower ends of the penstocks with the horizontal flange faces of the scroll case inlets is by means of cast-iron reducing elbows. Within these elbows the water passage is reduced from a diameter of 6½ to 4 feet.

A recent study of water metering possibilities at this plant led to the determination to attempt to make use of the pressure difference due to change in velocity in these elbows as a means of measuring discharge. Unit 3 was selected for the first trial. It was realized, of course, that standard venturi coefficients could not be expected to apply to a section of such shape, consequently calibration by pitometers was decided upon.

In order to obtain pressure differences which would not vary from time to time, some form of venturi connections which would not be affected by the formation of tubercles, etc., inside the penstock and turbine casing were required. For this purpose (see Fig. 1) brass studs were used, the faces being 1¾ in. in diameter for the large penstock section, where the velocity was low and 2¼ in. in diameter in the scroll inlet, where higher velocities prevailed. It was felt that these brass faces were of sufficient area to prevent the indications from being affected by any probable changes in the steel or iron surfaces surrounding them. Four studs, equally spaced around the circumfer-

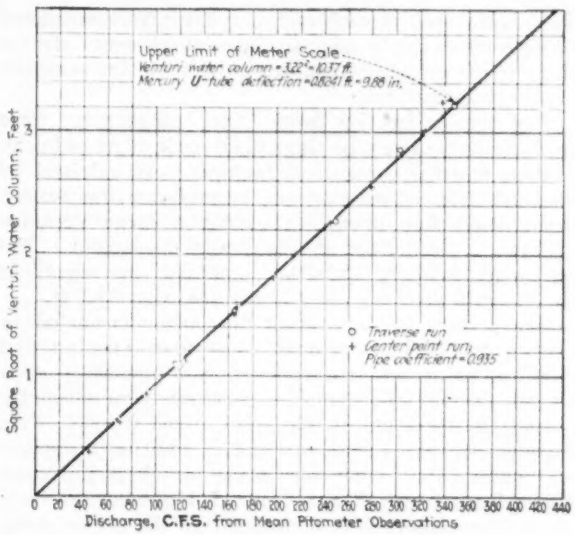

Upper Limit of Meter Scale
Venturi water column = 3.22' = 10.57 ft.
Mercury U-tube deflection = 0.8041 ft. = 9.65 in.
o Traverse run
+ Center point run
Pipe coefficient = 0.935
Square Root of Venturi Water Column, Feet
1
2
3
0 20 40 60 80 100 120 140 160 180 200 220 240 260 280 300 320 340 360 380 400 420 440
Discharge, C.F.S. from Mean Pitometer Observations

FIG. 2. VENTURI RATING CURVES FOR PENSTOCK AND SCROLL CASE INSTALLATION TEST OF OCT. 23-24, 1920

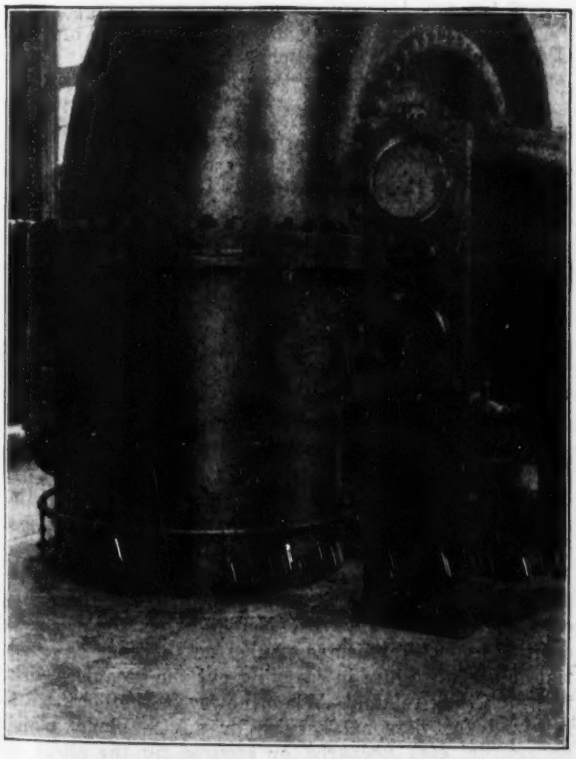


FIG. 3. FRONT VIEW OF RECORDING INSTRUMENT

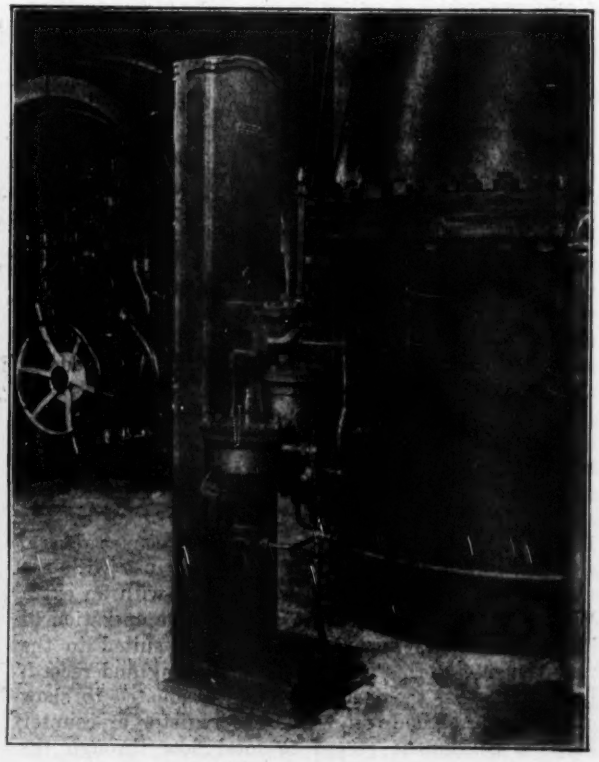


FIG. 4. REAR VIEW OF RECORDING INSTRUMENT

ence, were used at each section. They were connected outside by complete circular pipes of generous size in place of the pressure chambers provided in the standard venturi construction.

For the calibration work, hose connections were made from the two pipe rings to the ends of an ordinary U-tube, and the pressure differences were obtained by the deflection of mercury or bromoform, the former being used for discharges giving a large pressure difference, the latter at the lower discharges. The maximum mercury deflection obtained, corresponding to full gate discharge of the turbine, was 0.82 ft.

The process of calibrating the meter consisted in setting the turbine gate at some fixed opening and running pitometer traverses on two diameters at a section of the 7-ft. diameter penstock, simultaneously noting the deflection of the liquid in the U-tube. Five complete traverses were run and in addition a number of "center point" runs were made for check purposes. These "center point" runs consisted of comparatively short-time observations of velocity at the center point of the pipe, the discharge being determined by applying a ratio known as the "pipe coefficient" obtained from the traverses. The results of the calibration work are shown by Fig. 2, in which the discharge in cubic feet per second is plotted against the square root of the venturi pressure different, expressed in feet of water. It should be noted that the points plot up in a straight line, indicating that the discharge varies exactly as the square root of the venturi pressure difference, or in other words, the venturi coefficient, C, in the formula $Q = CA\sqrt{\frac{2gd}{1-\frac{a^2}{A}}}$ is a constant for all discharges, which, considering the shape of the converging section, is rather surprising. In this formula

A = area at venturi inlet;
a = area at venturi outlet;
d = venturi pressure drop, in feet of water;
g = acceleration due to gravity;
Q = discharge in cubic feet per second.

It is also surprising to note that in spite of the 90-deg. change in the direction of flow, the venturi coefficient is 0.985, practically identical with that of a standard venturi tube. The explanation of the slight loss in this bend is probably to be found in the fact that the velocity is being accelerated so that the formation of eddies is prevented. This is consistent with the well known tendency of a tapered nozzle to eliminate eddies and produce straight line flow.

In order to obtain a continuous record of discharge, as well as a permanent means of quickly checking turbine efficiency, a special indicator-register-recorder instrument, shown in Figs. 3 and 4, has just been installed. This instrument was manufactured by the Builders Iron Foundry, and is of the same general design as their standard instrument for use with the venturi meter. It is, however, provided with an extra large float to insure accurate and positive operation at low flows and is apparently very well suited to the requirements at this plant. The indicating and recording features of the instrument are graduated to show discharge in second-feet, while the register or counter keeps a continuous record to total flow through the meter in second-foot-hours. This latter unit was adopted as being convenient to use and easily understood by the operators on account of its similarity to the kilowatt-hour. It is of course the volume which passes in one hour when the flow is at the rate of one second-foot or 3,600 cu.ft.

Since the layouts of the three units in this plant are identical, it was not considered necessary to calibrate units 1 and 2. The controlling areas—penstock and inlet—of these were carefully measured and discharge curves were obtained by the use of the venturi coefficient obtained for unit 3. Meter pipe connections for these units were made identical with those of unit 3 but indicator-register-recorder instruments have not as yet been installed, mercury manometers, giving instantaneous readings only, being at present employed. These will later probably be replaced with the larger type. Fig. 5 shows the manometer for the No. 1 unit.

This meter outfit has been described at considerable length because it seems to be an exceptionally good example of what can be accomplished in the way of water measurement at very small initial cost and without the introduction of additional head losses, simply by the measurement of pressure variations already present. Moreover, it represents a condition which exists in many plants. While the average case may not be so simple or obvious as this, nevertheless a large percentage of plants of the higher head types will be found to offer possibilities of water metering by measurement of pressure changes or head losses which would be practically constant from year to year and would be of great value if properly utilized. Pressure differences as large as those obtained at these plants are by no means necessary, as instruments are obtainable which operate reliably with smaller differentials.

The meter installations at the Plant 5 were designed by the engineering department of the New England Power Co. and the calibration work was performed by engineers of this company under the direction of Prof. C. M. Allen of Worcester Polytechnic Institute.

Consulting Engineers Rule on Client's Right to Engineering Data

The Council of the American Institute of Consulting Engineers has announced its answer to the following question: "To what data and information is the client entitled from the retained engineer?"

The council considers that no fixed rule will apply to all cases, and that terms of engagement and basis and amount of compensation must often be taken into account. In general, however, the client "is entitled to all data and information obtained or developed during the progress of the engineer's work that may affect, directly, indirectly or incidentally his interest *in the particular project or purpose* regarding which the engineer is retained, and may properly call for such further data, details or explanations as he may think essential to enable him to deal with the contemplated project intelligently."

"Original notes, studies, documents, plans, computations, etc., relating to the engagement are the property of the engineer," says the council, "but the client is entitled to such duplicates or abstracts as may be essential or useful to him in carrying out the specific project to which they relate." When, however, the engineer is retained for personal service or advice alone, plans, documents, etc., prepared or secured by the client at his own expense, although advised or suggested by the engineer, belong to the client.

LETTERS TO THE EDITOR

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

Building Code Simplification

Sir—I wish to commend your editorial on the Knickerbocker Theater disaster. Whether other contributing causes are found or not in the official investigation the points you outline are vital. One point especially, it appears to me, needs emphasis at this time. It is covered in the statement, "Fostered by excess of detail in code requirements this dependence on formal rule needs to be combated by simplification of code rather than increase of detail and complexity."

Something like two years ago in attending a gathering to complete a state code the writer objected to the tendency toward great detail of specification. It is impossible and undesirable for many reasons, to attempt to cover all possible elements in a code. This should be self-evident. Among other things we restrict flexibility and ingenuity in design and discourage new developments in materials. It takes the time of state or city administrators of the code to instruct the incompetent, and leads to inefficiency and a lowering of standards all along the line. On the other hand the inducement should be towards improvement in plans and workmanship, and this can come only by the owner employing competent engineers or architects.

Our city departments now spend much time and money in checking and supervising to protect the public, including the owner himself, against the owner's indiscretion and mistaken policy of economy.

Compel the owner to employ competent men and the entire sky clears from many disturbing clouds at once.

Altoona, Pa., Feb. 16. W. A. HOYT.

"Wild" Publicity on Licensing

Sir—There are just three things that it is only fair to call to the attention of the readers of your interesting magazine about the editorials on page 264 of the issue of Feb. 16:

1. The American Association of Engineers approves licensing for engineers and has always done so. This is by action in conventions. Your editorial implies that advocating of licensing is not the "mature judgment of the association."

2. Licensing was the issue at stake in the bulletin, not the Knickerbocker Theater. It is assumed the disaster was a responsibility of the profession. The cure consistently advocated by the American Association of Engineers has been licensing. The doctrine of "I told you so" is always justified and even desirable in the case of loss of life.

3. Your editorial assumes that I was uninformed about the disaster. National news services were available to me which were probably unavailable to *Engineering News-Record*. The building failed, did it not? The facts as stated were correct. Where were they wrong? (See *Engineering News-Record*, Feb. 9, p. 221, "it was flimsy and lacked bond"; also Feb. 16, p. 294.)

Chicago Feb. 18, 1922. C. R. THOMAS,
In Charge, Public Information Service
American Association of Engineers

[The above letter refers to an editorial under the caption "Publicity Run Wild," denouncing a circular in which the Public Information Service of the American Association of Engineers exploited the Knickerbocker Theater calamity as an argument for licensing.

The Knickerbocker collapse was so grave that even a rudimentary sense of fitness should have forbidden utilizing it for advertising or propaganda, at least until all the facts were known. Yet Mr. Thomas now blandly offers the plea in extenuation that licensing was the issue at stake—for which stake, presumably, anything goes!

Its author reasons rather wilfully. The publicity circular not only was headed "COMMENT: KNICKERBOCKER THEATRE COLLAPSE. LICENSING ENGINEERS AND ARCHITECTS PROTECTS PUBLIC FROM BUILDING DISASTERS," but in its text it asserted that the causes of the collapse would not have existed had licensed engineers or architects supervised the construction. But Mr. Thomas now claims that the Knickerbocker Theater was not the issue. This singular statement may be chargeable to oversight or to disregard of the reader's point of view.

He is also somewhat disingenuous. The claims as to the cause of the Knickerbocker failure were directly followed by the explanation that license laws prevent "the activities of dabblers and quacks." Looking aside from the fact that even as a general statement this assertion is wild and unfounded, let us ask whether it was really meant to be quite dissociated in the reader's mind from the Knickerbocker case. We believe the reader will not fail to preceive its innuendo character.

Mr. Thomas' reference to "the doctrine of I told you so" can be interpreted in only one way: as an allusion to predictions that buildings erected by unlicensed engineers are liable to failure, and that correspondingly the whole of the past work of engineers is under suspicion. This of course is pure effrontery, and that of a particularly vicious sort. It is of a piece, however, with the tenor of the circular, which represented an attempt to play on the panic susceptibilities of the public in order to stampede it into swallowing the proposed cure.

We fear we must add that our correspondent does not deal very gently with the truth, in his letter. We wrote, "the public will take the press bulletin as representative of the matured judgment of the association." This he distorts into the alleged charge that "advocating of licensing is not the mature judgment of the association," a version hardly explainable on the ground of error in reading.

Strenuous, serious-minded effort backed by the full strength of public and professional support was necessary immediately after the Knickerbocker collapse, to shed light on the obscure facts of the accident. The Washington chapter of the association took up a share of the work right manfully. How mischievous a frivolous publicity blurb may prove under such circumstances is well appreciated by the men who were on the ground. To the credit of the association be it said that the efforts of its Washington chapter were not the least contribution to the result now being reached in clearing up the case; but no thanks to the publicity blurb for this!

This is not the place to discuss licensing. But we believe that many of our readers will join *Engineering News-Record* in the hope that licensing may be saved from some of its friends and publicity managers.—EDITOR.]

Questions Value of Licensing Laws

Sir—I have read with interest a letter addressed to you by L. G. Smith of Montgomery, Ala., entitled "Against Engineer Licensing Laws." [*Engineering News-Record*, Feb. 16, 1922, page 292.]

I am in hearty accord with Mr. Smith's position. I have never been able to understand why the engineers of this country have not protested against the enactment of licensing laws throughout the states. It cannot be shown that the licensing laws for doctors, operating engineers and firemen, barbers, plumbers and other "professions" have resulted in any public good. The present licensing laws for engineers that have been enacted in various states are absolutely of no use so far as the public is concerned and they cause the engineers throughout the country a great deal of trouble because of the necessity of obtaining licenses in different states where an engineer wishes to practice. The mere examination and granting of a license to an engineer by a board in any state does

not and cannot insure that that engineer or architect will design and supervise the construction of buildings always in a safe and reasonable manner. I know many men who are better qualified to supervise the construction of buildings because of their long experience in construction than many engineers who have obtained licenses in the various states.

I have never yet found an engineer of experience who was in favor of the licensing law. S. M. GREEN.

Springfield, Mass., Feb. 22.

Molded vs. Core Specimens of Concrete

Sir—I note in *Engineering News-Record*, Jan. 26, p. 165, a letter from Fred Kellam, testing engineer of the Indiana State Highway Department on my article in the issue of Jan. 12, p. 73.

Such a simple solution as given by Mr. Kellam would be rather encouraging in studying our concrete variables by means of utilization of a very broad formula, but unfortunately I find many errors in Mr. Kellam's method. For instance, reference is made to a publication by Professor Abrams in Proceedings of the American Society for Testing Materials, 1918, Part II. Two formulas are quoted which I would say, from consulting this publication, are derived from Figs. 13 and 16. Fig. 13 contains curves drawn from tests performed at the University of Illinois, representing 1:2:4 concrete of a normal consistency stored under moist conditions. Fig. 16 is plotted from Prof. Morsch's test, and represents 1:2½:5 concrete. No special reference is made in this case to storage, but I presume it is under normal laboratory moist storage conditions.

It seems to me as though an undue license has been taken in comparing the data which I published, which is a 1:2:3 concrete with a 1:2:4 and 1:2½:5, and finally determining that the 1:2:3 should be a mean value.

Attention is called to Mr. Kellam's Table A which was compiled from Table I of my article. In Table A a mean compressive strength is developed with the age as constant, no recognition is apparently taken of the fact that my table represented a series of tests from fourteen different projects, noted in the table as "Series Number." I took great pains to quote maximum and minimum values in the table so that a reader would not be misled regarding the mean value. The mean compressive strength as given in Table A by Mr. Kellam is really a mean derived from a mean with no recognition taken of any variables but age.

For further enlightenment on this subject I wish to submit the following tabulation which contains the strength data with the ages of individual specimens which are taken from Table II of my article. There might have been some justification if Mr. Kellam used this Table II as a basis for his Table A, in that at least these are all from one project; but even under such conditions, inspection of the last column labeled "per cent increases compression over 28-day specimens," should be indicative to any engineer, regardless of his test experience, that averages in such cases are artifical values. It will be noted that the strength increases from 4.5 per cent to 110.3 per cent regardless of age. Average results from such data is not only unreliable, but misleading.

TABLE X. COMPARATIVE STRENGTH MOLDED AND DRILLED CONCRETE SPECIMENS

Molded — Age	Molded — Compression Lb. per Sq.In.	Drilled — Age	Drilled — Compression Lb. per Sq.In.	Difference in Age Between Molded and Drilled Cores Days	Per Cent Increase Compression Over 28 Day Specimens
28	3,526	360	4,757	332	34.9
28	4,054	330	5,353	302	32.0
28	3,331	330	5,141	302	54.4
28	3,061	240	5,070	212	65.6
28	3,304	240	6,070	212	83.7
28	2,783	240	3,980	212	42.6
28	2,211	210	4,650	182	110.3
28	2,821	240	3,931	212	39.3
28	2,489	270	4,640	242	86.4
28	3,152	270	4,025	242	27.7
28	3,146	300	4,405	272	40.0
28	2,528	300	5,024	272	98.7
28	3,834	330	4,008	302	4.5

In submitting my article on the relation between molded and core concrete specimens, I wished to bring out several points, one was that molded specimens are not a positive indicator of the strength of concrete in place, as determined by the drilled specimens. An inspection of Table II readily indicates this. Further I stated that the general tendency of concrete drilled from the structure is to show a higher test in compression than the preliminary molded specimen would indicate. This can also be readily seen by inspection of both Tables I and II, especially noticeable in Table II that all the drilled specimens are about 4,000 lb. and over. This strength is not indicated in the molded specimens, in fact there seems to be a tendency for low molded specimens to show a high gain which would be readily seen in the accompanying table.

Also I wish to forcibly present the fact that we are not at the stage of concrete design where we can pre-determine the strength in the finished structure from a molded specimen.

Oftentimes individual tests or a series of tests represent the quality of the concrete laid on a project. This may vary in different locations of the same project, and under such conditions an average of the results of such tests give a false value. Now if we were to consider averages on tests taken from different projects where the variables are increased, the error would be multiplied to a considerable extent. H. S. MATTIMORE,

Harrisburg, Pa. Engineer of Tests,
Jan. 31. Pennsylvania State Highway Dept.

Fall Extension of Irrigation Season on Valier Project, Montana

Sir—Irrigation engineers in the irrigated districts of the Northwestern United States and in Canada, where the irrigation season is short, may be interested in a change in the irrigation season by the Montana Carey Land Board on Feb. 10, on petition of settlers representing 80 per cent of the 76,000 acres thus far sold in the Valier Project. The season will continue to open on May 1 but its closing time will be changed from Sept. 15 to Oct. 15, thus insuring a large fall acreage irrigated and a greater utilization of the water supply without additional construction outlay. From Aug. 15 to Sept. 15, the water will be shut off, thus affording an opportunity to do a large part of the maintenance work. GEORGE EBNER,

Valier, Mont., Operating Engineer,
Feb. 11. Valier-Montana Land & Water Co.

Aerial Photography in Map-Making

Sir—I am obliged to you for calling my attention to an article in the Feb. 2 issue of *Engineering News-Record*, p. 194, on "Uses of Aerial Photography in Map Making." I had seen the article before but had not been able to read it carefully and had not noticed the statement concerning work of this kind alleged to have been done by the Reclamation Service of the Canadian Government.

If the Canadian Reclamation Service had, as reported, photographed approximately 1,000,000 acres of land in connection with a proposed drainage project, I have no doubt that many of your readers would be interested in learning more about our methods and the results obtained. As a matter of fact, however, the report—like the famous one concerning Mark Twain's death—was "greatly exaggerated." The facts are as follows:

We are conducting surveys to determine the feasibility of draining a very large tract of overflowed land lying between the Saskatchewan and Carrot rivers in the provinces of Manitoba and Saskatchewan. The tract contains, roughly, some 900,000 acres. The interior of this tract is practically inaccessible except in winter, when the swamps and sloughs are frozen. During the summer season the water in many places is not deep enough to permit of the use of boats or canoes, while the water and deep mud make walking practically impossible. The difficulty of surveying lands of this class will be readily appreciated.

The engineer in charge of this work, G. F. Horsey, was at the Pas, Manitoba, when a seaplane, operated by officers

of the Canadian Air Force arrived, and he was fortunately able to arrange—purely as a matter of courtesy—for an observation trip over a part of the district which he was engaged in surveying. The actual trip lasted only two hours and covered approximately 120 miles. I quote the following from Mr. Horsey's letter to me under date Oct. 6, 1921:

"I cannot speak too highly of the benefit derived from a flight of this kind in connection with survey work on a project of the magnitude of the proposed Carrot River Triangle drainage project, involving as it does, an area of from 800,000 to 900,000 acres, a large part of which is practically inaccessible in the summer season on account of the flooded condition of the interior. Much of this district is unsurveyed and very little information regarding the topographical features is obtainable without running a traverse survey. From the air various drainage channels in the interior can be seen quite distinctly, and information of this kind would prove of great value in determining to a large extent where it would be necessary to run our interior traverse lines and where lines would not be necessary, thereby saving time and money. Information regarding the timber in the interior could also be obtained.

"I do not wish to convey the idea that numerous flights of this kind would obviate the necessity of making a detailed survey of a large drainage project, as distance, area, and rise and fall in land could only be obtained by running traverse lines and levels over the district; but I do think, in possibly half a dozen flights, the whole Carrot River triangle could be covered, and this would be of great assistance in enabling the engineers engaged on the work to get a general idea of the interior in a short space of time and would prove of value in planning the general layout of the work.

"From my personal experience I feel confident that I obtained more general information of the area covered in the two hours' flight that I made in the air than I could have learned in a month's trip on foot in the late fall or winter, during which seasons only, is it possible to travel in this section."

I do not know that the information I have been able to give you will be of general interest to any considerable number of your readers, but I am desirous of clearing up any misapprehension that may exist in the minds of your readers due to the inaccurate statement contained in the article of Feb. 2.

E. F. DRAKE,
Director, Reclamation Service,
Department of the Interior.

Ottawa, Canada,
Feb. 24.

Concrete Flumes on the King Hill Project

Sir—I am very much interested in the article which appeared in *Engineering News-Record*, Dec. 8, 1921, p. 196, written by Walter Ward of the King Hill Project. At the outset of that paper Mr. Ward discusses semi-circular wood-stave flume and galvanized flume as compared with concrete flume. Based on the estimates of cost as prepared by him in 1917, he concludes that the concrete flume would be the cheapest type of construction. Information on the following points would be enlightening: [Questions are noted in Mr. Ward's letter followed by his answers.—Editor.]

In view of the article [on "Nashville Concrete Bridges Show Serious Deterioration."—Ed.] appearing in the same issue on page 934, and the past experience that the Reclamation Service has had with concrete flume structures, I am somewhat surprised at Mr. Ward's assumptions as to the length of life and cost, full consideration being given to the cost of maintenance during the useful life as assumed.

E. J. BARTELLS,
Consulting Engineer.

Seattle, Wash., Dec. 29, 1921.

Sir—Referring to the letter from Mr. Bartells, asking certain questions relative to the article on flumes in *Engineering News-Record*. I am submitting below answers to the questions:

Q. What type of semi-circular wood-stave flume was contemplated?

A. Estimates were made on untreated wood-stave flumes of both fir and redwood. The estimated cost of $9.20 per lin.ft. mentioned in the article was based on untreated fir stave flume of the usual type of which a considerable quantity was later installed on the King Hill Project for flume on trestle.

Q. On what data did he base his assumption of a life of 20 years for wood-stave flume and galvanized metal 14-gage?

A. The life of 20 years for untreated stave flume was based largely on the condition of untreated wood-stave pipes (installed above ground) of known age on the King Hill Project and other projects of the Reclamation Service. It was also based on a careful investigation of two installations of untreated wood-stave flume, one of redwood staves which had reached about the end of its useful life after 21 years, and another of fir staves which required building with 36 per cent of the staves replaced after 12 years. At the time the estimates on these flumes were prepared (1917) treated stave flumes had never to my knowledge been used for flume purposes and to only a very limited extent for wood-stave pipe. Treated staves were, therefore, not considered for these flumes.

The life of 20 years for 14-gage galvanized metal flume was based on the known life and estimated remaining life of metal-flume installation on many of the Reclamation Service and other projects. In fixing the comparatively long life for both metal flume and untreated wood-stave flume, it was contemplated that a considerable amount of maintenance work would be necessary. The estimated capitalized costs included a liberal amount for maintenance.

Q. Have the data now in possession of the Reclamation Service on metal flumes been available to Mr. Ward?

A. As most of the data on metal flumes have been collected during the past few years these data were not available in 1917 when the comparative estimates on these flumes were prepared.

Q. How is the useful life of 50 years for concrete flume arrived at?

A. This estimate of the useful life of concrete was, of course, based on the best judgment of the engineers of the Reclamation Service, having in mind the local conditions and materials available on the King Hill Project. The concrete in the flumes is heavily reinforced and of rich mixture, and it is my personal opinion, after completing the construction of these flumes, that their useful life will be very much greater than 50 years.

Q. Mr. Ward states that all estimates were based on a carrying capacity of 300 sec.-ft. Was there any allowance made in the cross-sectional area for the different types of flume due to the difference in the resistance to flow of water? Was this factor included in the cost?

A. The estimates for the different types were based on designs of equal capacity using different values of Kutter's n and the costs were therefore compared on a fair basis.

In the last paragraph of Mr. Bartells' letter he refers to the past experience of the Reclamation Service with concrete flumes. From a letter received by me from Mr. Bartells it is understood that he has in mind the necessary enlargement of the concrete flume on the Tieton Unit of the Yakima Project. The enlargement of this flume was due to the fact that Kutter's n was originally assumed too low and it was in no way necessitated by any failure of the concrete in the flume. Some maintenance work was done on the flume at the time of its enlargement; however, the concrete in this flume is known to be in excellent condition after 14 years.

WALTER WARD,
Project Manager,
U. S. Reclamation Service.

King Hill, Idaho, Jan. 23.

NEWS OF THE WEEK

New York, March 2, 1922

Vast Supplies of Water for Jersey District

Hazen Reports on Additional Project for 5,600,000 People in Metropolitan Area in 1970

Three times the water needed to supply the population of the New Jersey Metropolitan District in 1970, or 2,500 m.g.d. for an estimated population of 5,600,000, could readily be provided by supplementing existing supplies by additional reservoirs and conduits, and still leave untouched a large possible supply in the southern part of the state, according to a report by Allen Hazen, of Hazen, Whipple & Fuller, New York City, submitted to the New Jersey Board of Conservation and Development.

To raise the present yields to the 820 m.g.d. needed in 1970 the choice among several possibilities lies between a reservoir on the Lower Passaic, to be formed by a long dam at Little Falls, and a short dam on the Upper Passaic, at or near Millington, with filtration in either case. The Passaic Great Reservoir , above Little Falls, would not only provide a large water supply, but it would also solve the Passaic flood problem—a smaller reservoir for flood protection was proposed here after the great flood of 1903—and would eliminate large areas of mosquito breeding grounds, but this project would require a large outlay at the start, long before all the stored water would be needed for consumption. The Upper Passaic, or Long Hill Reservoir, has the advantages of (1) proximity to the great centers of consumption—a tunnel only 19 miles long would reach Jersey City, passing beneath Newark en route—and (2) of low initial cost, since the reservoir named would be only the first of a series extending westward to within a mile of the Delaware River, from which large volumes could be pumped to the most westward reservoir and flow thence by gravity through various aqueducts, streams and reservoirs to the Long Hill Reservoir. Further details from Mr. Hazen's report will be printed in a later issue.

Reports on Large Reclamation Project in Washington

A project contemplating the irrigation of 2,000,000 acres of arid land in the central part of the State Washington by pumping water from the Columbia River into a coulee, which will form the main supply canal is the subject of a report to the State Department of Conservation and Development, just completed by Willis T. Batcheller, consulting engineer, of Seattle. About 1,500,000 hp. will be required for pumping purposes and additional amounts of commercial power up to 1,000,000 hp. can be economically developed at the proposed site. Mr. Batcheller's report is now being reviewed by Gen. George W. Goethals, who is spending several weeks in Spokane.

Bids on 168-Mile Road Job in Arizona

(By wire to Engineering News-Record)

Bids for the construction of 168 miles of highway in Maricopa County, Arizona, were opened Feb. 27.

Twohy Bros., Phoenix, were low on concrete at following unit prices per square yard: 6-in., $2.31; 5-in. $2.02. The Independent Asphalt Paving Co., Seattle, bid as follows: 6-in., $2.51; 5-in., $2.28. The bid of the Warren Construction Co., Portland, was: 6-in., $2.49; 5-in., $2.29.

The asphalt bids were: California Construction Co., San Francisco, 6-in. asphaltic concrete, $2.00; 5-in., $1.75. Warren Construction Co., 6-in. asphaltic concrete, $2.10; 5-in., $1.91; Bitulithic, 6-in., $2.21; 5-in. $2.01.

It is expected that the Maricopa County Commission will make an award this week.

Katy To Build $3,000,000 Terminal Yards and Shops in Texas

Announcement has been made that the Missouri, Kansas & Texas Railroad of Texas will soon begin construction on a $3,000,000 terminal in Denison, consisting of a double-hump switching yard, roundhouse, shops, storerooms, warehouses, fuel-oil-storage tanks and other facilities, which, when completed, will cover some 400 acres. The contract for grading the yards and the concrete work has been let to the Cummins Construction Co., of Cleveland, Ohio, and it is estimated that it will require 18 months to complete the terminal.

The Katy is constructing this terminal to facilitate the handling of heavy-freight business from and to Texas with the highest efficiency and a lower cost. The yards proper will extend approximately 3 miles in length and about 2 miles at the widest point, making them the largest west of the Mississippi.

The new yards will begin about a half a mile west of the city limits, extending toward Pottsboro, and a new freight line right-of-way will run from the new terminal to Pottsboro.

Mechanical Engineers To Hold Standardization Conference

The American Society of Mechanical Engineers will take up the question of standardization and research at a five-day meeting to be held in Atlanta, Ga., beginning May 8. In a recent survey of engineering and industrial standardization, the society urges industrial leaders to give serious study to German plans. It is presumed that a large part of the discussion to be undertaken at Atlanta will be based upon comparisons of European and American standardization plans and practices.

E. C. Peck of Cleveland is chairman of the standardization committee of the society.

Practising Engineers Meet To Discuss Problems

Engineers as Advertisers—Selling Services—Retainers and Standard Fees—Licensing Laws

How an engineer in private practice may secure publicity and solicit work and how fees for engineering services may be regulated were the main features of a meeting of practising engineers held in Chicago Feb. 22, at the call of the American Association of Engineers. The attendance was disappointing, barely a score of engineers being present at the two sessions presided over by Langdon Pearse, sanitary engineer of the Sanitary District of Chicago.

The difference between publicity and advertising and the tendency of the practising engineer to shun the latter while courting the former were shown by Morris W. Lee, vice-president of the engineering firm of Frank D. Chase, Inc. An engineer may circulate copies of articles (perhaps written by himself) describing his works, but he will limit his newspaper advertising to a small card and will not mention his work. Mr. Lee advocated a more extensive use of personal advertising in technical papers, pointing out that greater publicity for engineering work will not only benefit the engineer but will have a valuable educational effect upon clients and public opinion.

Whether engineers are business or professional men was a question propounded by one speaker, who took the position that the engineer is a business man, and as such should advertise freely. But another speaker countered by quoting restrictive rules of certain codes of ethics. How to sell engineer-services was the subject of a paper by Paul E. Green, consulting engineer. This supplemented Mr. Lee's paper and abstracts of both will appear in a later issue.

Standard for Fees

That the limits of compensation are the value of service to the client and the cost of service to the engineer was a point made by Gardner S. Williams, Ann Arbor, Mich., in a paper on standards of services and fees. All but the simplest cases involve judgment, which is the result of training, ability and experience. Since this introduces the item of individuality, any schedule of fees must be for minimum fees. Maintenance of fees requires such cooperation among engineers as will prevent underbidding and rate-cutting. The engineer of special attainments should capitalize these by demanding higher pay, but too frequently he acts on the assumption that his high attainments enable him to do work for lower pay. In the same way, an engineer employed by a state or municipality for a portion of his time as a consultant, Mr. Williams maintained, should not underbid his fellows and deprive them of ligitimate return, because his possession of a salary enables him to do outside work

Philadelphia Engineers to Enter Local Zoning Campaign

A joint meeting to consider the zoning situation in Philadelphia, including the strong opposition which has temporarily blocked the proposed zoning ordinance recently submitted to the City Council, is to be held on March 6 under the combined auspices of the Engineers' Club of Philadelphia, the Philadelphia sections of the American Society of Civil and of Mechanical Engineers, the Real Estate Board, and other interested bodies.

Urges Federal Action to Advance Commercial Air-Transport

Broad enabling legislation to cover the field of commercial aeronautics is advocated by the board of directors of the Chamber of Commerce of the United States, which has authorized the department of transportation and communication of the chamber to interest itself actively in the subject.

A report of the department advisory committee recommends basic national legislation to provide for the adoption and administration of an aeronautic code, promotion by the Department of Commerce of the development and regulation of interstate and foreign commercial air transport, intra-state action to conform to federal legislation and encouragement of public support for the movement.

Among the specific and practical steps that have been suggested are the cooperation of localities in providing properly equipped air-harbors and airlanes, provision by the federal government of aerological and radio broadcasting service and continuance of the pioneer development work of the U. S. Air Mail until further progress shall have made it possible for private enterprise to assume this task.

Advisory Committee Named

The department advisory committee that has been considering the subject consists of Howard Elliott, chairman of the board, Northern Pacific Railway Co., Lewis B. Stilwell, consulting engineer, A. J. Brosseau, president, International Motor Co., J. J. Carty, vice-president, American Telephone & Telegraph Co., B. F. Cresson, Jr., chief engineer, The Port of New York Authority, Edwin O. Edgerton, president, East Bay Water Co., San Francisco, Douglas A. Fiske, president Northwest Terminal Co., Minneapolis, Philip H. Gadsden, vice-president, United Gas Improvement Co., George A. Post, president, Hudson River Bridge & Terminal Assn., H. H. Raymond, president, Clyde Line, Wilmer W. Salmon, president, General Railway Signal Co., Lucius Teter, president, Chicago Trust Co., J. M. Whitsitt, president, The Carolina Co., and J. Rowland Bibbins, department manager.

Port Authority Plans Approved

Authority to proceed with its comprehensive plan for the development of New York Harbor has been granted to the Port of New York Authority by the states of New York and New Jersey, Governor Miller having signed the New York bill on Feb. 24, and Governor Edwards having signed for New Jersey on Feb. 25.

The plan of the Port Authority was described in *Engineering News-Record* of Jan. 5, 1922, p. 26. Under the terms of the acts the Port Authority has no power to raise money by taxation or by pledging the credit of either state. It must finance its operations out of the proceeds of bonds based on the improvement itself and sold to the investing public. Each state has appropriated $100,000 to meet the expenses of the Port Authority during the current year.

more cheaply. Mr. Williams referred to well-known conditions of extreme variations of bids made in open competition. He suggested that to ensure adequate compensation for services, the principles of a retainer fee may well be adopted, particularly in consulting practice. This fee might be from $500 for 3-day service up to $2,500 for 10-day service, this to be followed by a per-diem charge of say $100, plus expenses. As long as the engineer works only for per-diem payment, his compensation is measured by physical output rather than by mental attainment.

In the discussion, L. K. Sherman, Chicago, divided practising engineers into three classes: (1) The man with an office and established business; (2) the man in salaried position who takes private work on the side; (3) the man out of work who is trying to pick up some practice. He agreed with Mr. Williams that the basis of fees should be the value of service to the client and not simply the cost of the service, but in general only the latter is considered. In Mr. Sherman's opinion engineers are tending toward the establishment of business organizations to regulate practice, as in other lines and professions. He suggested that such an organization should be composed exclusively of practising engineers. It was contended by D. B. Luten, Indianapolis, that the establishment of minimum fees is not in the public interest.

Cost Accounting

Cost accounting for engineering service was discussed in a paper by Arthur L. Mullergren, Kansas City, who was followed by Clarence W. Hubbell, Detroit, with a talk on the computing of an engineer's income tax. Both of these papers led to discussions on vexed points. Discussion on engineers' license laws followed the reading of a letter from C. S. Hammatt, president of the National Council of Engineering Examiners. Concerning state reciprocity for licensed engineers, Mr. Hammatt explained that since there is no uniformity in legislation for licensing or registration there is no reciprocity, although the various state laws aim to provide for it. Even for the states which have become members of the National Council of State Boards of Examiners this reciprocity cannot exist until the Council agrees upon a uniform set of requirements. Mr. Luten suggested that contractors might in some cases be classed as engineers and he remarked that a large proportion of accidents on construction work are due to the temporary structures employed.

Mr. Williams, in the paper noted above, stated that a law which says all engineers are equal cannot assist in establishing standards worth maintaining.

Minnesota's Ten Federated Societies Meet

Engineers Co-operate With Architects —Program Prepared for Year's Activities Extensive

(Engineering News-Record Staff Report)

Evidence that Minnesota's engineers and architects are working together in close harmony was furnished by the joint meeting, Feb. 21-23, at Minneapolis, of the Federation of Architectural and Engineering Societies (composed of ten organizations), and the Minnesota Surveyors and Engineers Society. About 350 members and guests were registered. On the last day three simultaneous meetings of the municipal highway and drainage sections, all well attended, were held. The formation of the federation has put added life into the state society, which is looked upon as serving best the needs of those living outside the larger centers — the highway and drainage engineers and the surveyors.

Outstanding features in the program of the federation were the list of achievements and the formidable program for the future as outlined by the committee on resolutions, which the president, with forethought, had appointed ten days previous to the meeting.

Of greatest importance to the state society were: The adoption of a new constitution creating four autonomous societies, for three of which programs had been prepared; the determination to stick by the federation; and a request that the federation amend the registration law, making it compulsory for engineers, architects and surveyors in public work to be registered.

The Federation's Work

Achievements of the federation come under two heads: (1) The *Bulletin*, sent to 1,229 members; and (2) the activities of the 15 members of the board of directors who spend several hours each month on problems of the profession. The work of the board included the following items:

Assistance to the governor in appointing a registration board of examiners, after securing passage of a licensing bill; conference with the University of Minnesota officials regarding a research department which has been established, but without specific appropriation; co-operation with the national committee on the classification and compensation of engineers in Minneapolis railway and federal service; congressional action on the bill for commissioning sanitary engineers in the Public Health Service and another bill on appropriation of funds to complete the typographical map in Minnesota; endorsement of the Great Lakes-St. Lawrence waterway; co-operation with a joint survey committee concerning the duties, classifiaction and compensation of engineers and architects and other employees of the city of Minneapolis; similar co-operation with the St. Paul Research Bureau.

R. A. Shelgren, secretary of the federation, in his annual report suggested extending the scope of the *Bulletin* so that an editorial staff would be necessary in each of the member societies.

In addition to the work noted, George H. Herrold, chairman of the public affairs committee, stated that the ques-

tion of equalizing salaries of engineering professors at the university with those of the other professions had been taken up. This committee also assisted the state committee on unemployment and had conferred with satisfactory results with the State Securities Commission on the methods of handling engineering reports.

The Architects' Small-House Service Bureau is the name of an organization growing out of committee work of the American Institute of Architects, appointed to see what the profession could do to assist the small-house situation. It has produced 100 stock plans of three- to six-room houses drawn by architects and sold to anyone at a nominal cost. It is a professional experiment and is the architects' contribution to the solution of the house-shortage problem. If an inquiry is made for plans of a house of over six rooms the party is advised to consult an architect.

J. A. Childs, assistant engineer, Minnesota State Board of Health, in his paper on "The Status of Sewage Disposal in Minnesota" indicated a liberal policy in that the board requires that sewage be treated to prevent nuisance and preserve fish life, rather than to take the place of water filter plants.

Progress in Research

"Engineering Research at the University of Minnesota" was the subject of Dean O. M. Leland's paper in which he noted the fact that the state's agricultural products were worth only $618,000,000 while the manufacturing production was $1,218,000,000. Mining was only $130,000,000. Research was desired, he said, on house heating, building construction, highway construction and maintenance, automobile fuels, and the utilization of waste products of industry. The university has established an engineering experiment station, but as it is as yet without funds, the federation will assist in getting $30,000 for this purpose.

In the report of the State Board of Registration for architects, engineers and land surveyors, Paul Doty, chairman, indicated that only 330 applications had been received. The relative numbers were 100 architects, 214 engineers, and 16 surveyors. There are 1,500 eligibles in the state who should register, he said.

Work laid out for the federation during the coming year is well defined by the numerous resolutions passed. Among them are the following, on which the board of directors will act at its monthly meetings: Financial support for technical research is to be asked from the state legislature. A list of eligible engineers and architects is to be handed the governor, from which he will be urged to choose a member of the board of regents of the University of Minnesota. The legislature is to be asked to provide the university with funds to develop methods of peat manufacture and utilization along commercial lines. A law to control the proper utilization of the water resources of the state will be supported.

Appropriations by the state for hydrographic investigation and topographic surveys to meet equal amounts furnished by the Federal appropriation were endorsed. The present registration law lacks "teeth" and the board was asked to form a committee to prepare a "strengthening" amendment. Endorsement of the St. Lawrence Tidewater project was given.

Municipal Section

In the municipal section of the state society a committee was authorized to consider contracts for engineering services and to co-operate with the Missouri Valley Association of Practising Engineers formed recently in Sioux City, Ia., for the same purpose. Standard specifications and contracts, discussed by L. P. Wolff, consulting engineer, and engineering costs on municipal work, by George M. Shepard, consulting engineer, led to the foregoing action.

Prof. W. L. Huff, University of Minnesota, gave the results of applying copper sulphate to a chain of five summer resort lakes near Fairmont to eradicate algae. Applications at 4 to 5-week intervals cleared up the nuisance which in previous years had often closed the lake resorts long before the season was over.

Drainage Section

"The Relation of Surface Run-off and Soil Type and Permeability to Drainage Design" was the subject of a highly technical paper by C. E. Ramser, senior drainage engineer, Washington, D. C. The problem of getting better tile was handled by D. G. Miller, senior drainage engineer, U. S. Bureau of Public Roads, who told of the deleterious effects of alkali on porous tile. Manufacturers present indicated that they proposed to deliver what the engineer specified and to eliminate those of their number who failed to produce dense tile. E. V. Willard, state drainage commissioner, was emphatic in his requests that the companies "clean house" and produce good material.

Highway Section

The new federal highway law was explained by E. O. Hathaway, district engineer, Bureau of Public Roads.

F. C. Lang, testing engineer, Minnesota State Highway Department, gave test results of cores drilled from pavements on at least every half mile of every state concrete pavement.

Maintenance of Minnesota's trunk highway system undertaken first in 1921, was discussed by M. J. Hoffman, assistant maintenance engineer, who explained in detail the methods and results obtained in taking over 7,000 miles of road from the counties, the formation of 16 districts and the expansion of the force until in October $490,000 was expended and more than 3,100 employees were on the payroll.

New Officers

The newly elected officers of the state society are as follows: President, John L. Pickles; vice-president, C. L. Mott; and secretary-treasurer, E. G. Briggs, St. Paul. Adolph F. Meyer was re-elected to the society's representation on the board of directors of the federation. William C. Fraser is the hold-over representative.

Utah Announces Road Program

The State Highway Department of Utah has announced its program of highway construction for the year 1922, involving 101.54 miles of road to be built at an estimated cost of $2,530,000. Sixteen projects ranging in length from 1 to 15 miles are included in the proposed work.

Westchester County Park System at $10,000,000 Cost Proposed

A bill authorizing the board of supervisors of Westchester County, N. Y., to appoint a commission of nine members with power to plan a park system for the county and take lands by condemnation was introduced in the New York legislature Feb. 20 by T. Channing Moore, assemblyman from Bronxville. The financing of the project would be controlled by the supervisors. The general plan is to provide parks from the Hudson River to Long Island Sound and from the north to the south end of the county. It is presumed that the Croton reservoirs of the New York water supply would be brought into or connected with the system.

Court Order Compels Seattle to Choose New Reservoir Site

The State Supreme Court of Washington, sitting *en banc* an. 3, reversed its department decision of last August, and upheld the King County Superior Court in declaring that the proposed Volunteer Park storage reservoir for the water-works of Seattle would be a menace to property and therefore cannot be built. It is estimated that an available site on Capitol Hill would cost $432,000. Notes on the earlier stages of the litigation appeared in *Engineering News-Record*, Jan. 6, 1921, p. 47, and Jan. 5, 1922, p. 35.

$7,000,000 for Construction in Duluth and Vicinity

A survey of the construction outlook in Duluth and adjoining districts shows that six projects involving expenditures estimated at $7,000,000 are scheduled for the coming season. Work upon them will be started by April 1 and approximately 6,000 men will be afforded employment during the season. Engineers and contractors assert that sufficient other work is in sight to absorb all the unemployed labor existing in this district today.

The state of Minnesota, under the Babcock law, will expend fully $2,000,000 in road work in St. Louis County this year, the contracts for which have been already let. St. Louis County proper will, in addition, expend $1,481,050 in the construction and maintenance of roads and bridges for which 1,500 men will be employed by contractors.

The program of the City of Duluth for 1922 calls for an expenditure of approximately $1,000,000 in street paving projects for which several contracts have been already let. More than 1,000 men will be employed by contractors on those jobs.

In building construction the projects to be carried through in Duluth include an apartment building, estimated to cost $800,000, for which German & Jenssen, Duluth, are the architects; an addition to St. Luke's hospital, to cost $750,000 for which the same firm is the associate architect; and a new county jail to be built in Duluth at an outlay of $375,000. Bids on the last-named contract will be taken on March 7.

While the projects enumerated are the principal jobs to be done this summer, the survey showed that activity is planned in other circles. House building promises to be on a large scale in Duluth this year.

Two Power Permits Granted for Alaskan Development

A preliminary permit has been authorized for issuance to Maurice J. Leehey of Seattle, Washington, for a proposed development of 15,000 hp. on Revillagigedo Island, Alaska. The plans contemplate the conversion of Lake Mahoney into a storage reservoir by the construction of a dam 50 ft. high. A tunnel 7,000 ft. long through the divide separating Lake Mahoney from upper Beaver Lake will divert this water into Beaver Falls Creek.

A preliminary permit has also been authorized for issuance to the Alaska Development and Mineral Co., a subsidiary of the Kennecott Copper Corp., for a comprehensive water-power development on Tyee and Anan Creeks, both tributary to the Bradfield Canal, Alaska. The power will be used in the manufacture of paper and pulp.

License Authorized for Power Project on American River

A license for a comprehensive power development on the South Fork of the American River, in the vicinity of Placerville, Cal., has been authorized by the Federal Power Commission for issuance to the El Dorado Power Co., a subsidiary of the Western States Gas and Electric Co.

The project as proposed utilizes an existing canal, 25 miles in length, known as the El Dorado ditch which will divert water from American River, a short distance below its confluence with Silver Fork. The canal will be enlarged from a capacity of 40 to 350 cu.ft. per second. From the canal the water will be conducted through a 3-mile conduit to the penstocks which supply the turbines to be located in a power house on the American River about a mile below the mouth of Silver Creek. The turbines will operate under a head of 1,900 ft. The company plans to provide for an ultimate installation of 100,000 hp. to be developed in four stages.

The project includes six storage reservoirs on the headwaters of American River, with an ultimate capacity of 90,000 acre-ft. Three of the reservoirs, to the capacity already constructed, are included in a license recently issued to the Western States Gas and Electric Co. The El Dorado Power Co. will acquire all water and property rights involved in these reservoirs, and it is intended to amend the present license later to include them.

The public hearings on this project brought out data showing that the greatest economic use for irrigation purposes alone demanded that as much as possible of the water on the upper American River be used for power. By generating electric energy in the mountains and transmitting it to the highly productive agricultural area in the vicinity of Stockton, about 3 acres per horsepower can be irrigated by electric pumping. If the water necessary to produce the electric energy were to be diverted to irrigation uses in the upper American River drainage, the equivalent usefulness of the water would be ¹ acre per horsepower. Furthermore, but little of the water diverted to irrigation use on the upper American River drainage could again be productively used, whereas the same water, if used to generate electricity, can be used again for the same purpose at a plant lower down on the stream.

President Signs Patent Office Relief Bill

President Harding signed the Patent Office relief bill on February 18. Since the bill carries only the authorization for the appropriation, the reorganization and installation of additional personnel must await the actual granting of the money. It is probable, however, that the appropriation can be carried in a forthcoming deficiency bill. The change in patent fees does not become effective until April 19.

Porto Rico Irrigation Project

Extensive subsoil investigations by test pits and core drilling are being carried on for the dam of the Isabela irrigation project of the Department of the Interior in Porto Rico at Quebradillas. R. A. Gonzalez, chief engineer, states that two field parties are surveying the reservoir site and making preliminary canal locations. The dam as now projected will be 130 ft. high, and store 33,000 acre-ft. of water which will irrigate 16,000 acres of cane land. About 12 miles from the dam a 100-ft. drop in the main canal will be utilized to develop 800 hp. The project will cost approximately $3,000,000.

Viaduct Planned Over Union Pacific Tracks at Ogden

The State Road Commission of Utan has had plans prepared by the bridge department for a concrete viaduct over the Union Pacific tracks at Ogden, Utah. Plans have to be approved by the engineers of the Bureau of Public Roads and by the bridge department of the Union Pacific. In addition to the viaduct there will be a steel bridge on each end with a span of 132 ft. A clear roadway of 20 ft. will be provided and a 5-ft. sidewalk. The structure will be lighted electrically.

The state road commission will have charge of the construction the estimated cost of which is $200,000.

Major Portion Chicago Building Under Landis Award

Statistics on Chicago building operations of January as announced in *Chicago Commerce* indicate that the Citizens Committee to inforce the Landis award is making substantial progress. Of the $8,063,700 estimated cost of 313 buildings for which permits were taken out in January; the total value of the Landis award jobs was $5,893,450; no report was obtained on work valued at $596,050.

William P. Curran, the president of the Chicago Building Trades Council, who is connected with the plumbers union, one of the ten refusing to accept the award, has been replaced by Fred Mader, head of the fixture hangers union. Mr. Curran was successful in bringing the council to accept the award but his own union repudiated the award.

The Illinois Society of Architects has passed resolutions against signing contracts with the plumbing contractors unless the latter work under the award.

Advertisements in the daily newspapers by the Citizens Committee and contractors Associations are continued at intervals apprising the people of the stand of the committee in maintaining an open shop for the 10 recalcitrant unions and backing the 22 unions which have accepted the award.

Robert Brewster Stanton

Engineer Who Surveyed 1,000-Mile Colorado Canyon Railway in 1889 Died Feb. 23

Robert Brewster Stanton, who surveyed a thousand-mile railway line from Grand Junction, Colo., to the mouth of the Colorado River, through the Grand and Marble and other canyons of the Colorado, died of pneumonia at Stamford, Conn., Feb. 23. He was born at Woodville, Miss., Aug. 5, 1846, and took the degrees of A.B. and A.M. at Miami University in 1871 and 1878. From 1874 to 1880 he was resident engineer of the Cincinnati Southern R.R. and from 1880 to 1884 he was division engineer for the Union Pacific Ry. During the latter engagement he built the celebrated Georgetown Loop Ry. in 1882-3.

Beginning in 1884, Mr. Stanton practised as a consulting civil and mining engineer, making the Grand Canyon Ry. survey in 1889-90 and subsequently being engineer also of various mines in the United States, Canada, Mexico, the West and East Indies, and in Cuba. In 1904 he was engaged in explorations for gold in the Island of Sumatra, Dutch East Indies.

The Grand Canyon survey was made by Mr. Stanton as chief engineer for the Denver, Colorado Canyon & Pacific Ry., a project designed to provide a freight, passenger and scenic railway on favorable grades down the Grand River from Grand Junction, Colo., to the Colorado River, and then down the latter stream to the Needles, Cal., and onward to a point near the Gulf of California. The total distance of the projected line was 1,038 miles, or 1,019 miles in case of adoption of a long tunnel line in Grand Canyon. About 140 miles of this distance was down the Grand River, leaving about an even 1,000 miles, if the longer route were chosen, on the Colorado River, of which 217 were in the Grand Canyon and some 220 miles in various other canyons and "cataract" portions of the river.

First Expedition Fails

The expedition began in 1889 but met with disaster in July, 1889, when, due to the capsizing of a boat on July 10, Frank M. Brown, president of the company, lost his life. Notes by Mr. Stanton describing the first expedition, accompanied by illustrations from his photographs, were published in *Engineering News*, Sept. 21, 1889. A detailed article by Mr. Stanton, with twenty-five illustrations, reviewing the entire survey, occupied some nine pages of *Engineering News* for Oct. 18, 1890. Editorial discussions of the project, in the well known vein of A. M. Wellington, then one of the editors of *Engineering News*, appeared in each of the issues last mentioned. The spirited account of a mishap by which F. A. Nims, the photographer of the party, fell 22 ft. and broke an ankle bone, was published in *Engineering News*, March 8, 1890, this story being based upon one by Mr. Stanton that appeared in the Denver *Republican* of Feb. 16, 1890. Immediately following the accident to the photographer, Mr. Stanton walked 35 miles to Lees Ferry to secure a wagon to take the injured man away for treatment. It required eight men working nearly a day to get Nims from the bed to the rim of the canyon.

In the second and fully successful

expedition, ending early in 1890, no more serious accidents appear to have occurred than the one just noted. In this expedition the party passed over no less than 520 rapids. Most of these are described as slight, but in the most troublesome one Mr. Stanton "was sucked downward by a whirlpool and only escaped after an unpleasantly long submersion."

Besides being the author of "The Canyons of the Colorado River of the West for Railway Purposes," published in 1892, Mr. Stanton in 1897 presented a lengthy paper to the Institution of Civil Engineers on "The Great Landslides on the Canadian Pacific Ry. in British Columbia."

Road Building Plans Take Shape in Alabama

On Jan. 30, the date on which the electors of Alabama approved by a 25 to 1 vote a $25,000,000 bond issue for the construction of state roads. Jefferson County also held an election to change from 5 per cent to 6 per cent the interest rate on $2,000,000 of bonds that had been previously authorized in order to make them marketable. This passed by a majority of about 8 to 1.

The Alabama Highway Commission has its plans well developed already and is preparing to dispose of some $3,000,000 of the bonds at once to meet the same amount of federal-aid funds now available.

In the same way Jefferson County is now preparing to begin construction on 200 miles of road in the county. Conferences are being held with the officials of the state highway commission and with those of the City of Birmingham looking to cooperation in the construction of portions of this mileage. About 17 miles will lie within the City of Birmingham and of this the County will pay one-half and the city the balance. About 70 miles will be state roads, connecting county seats, and to this the state and federal aid will pay one-half and the county one half.

Brady Succeeds Miller as Building Superintendent

Charles Brady, former chief inspector of the bureau, has succeeded Rudolph P. Miller, as Superintendent of Buildings, Borough of Manhattan, New York. Mr. Miller resigned recently because of ill health. Mr. Brady has, for a number of years, been in contracting work, having been the head of the Charles Brady Co., New York City. Mr. Miller, it is understood, will rest for a time, and then will enter private engineering practice. The change became effective Jan. 11.

Departments Consolidated Under City Engineer

The departments of engineering, streets and bridges of Raymond, Wash., were combined into a single department of engineering by the City Commission on Feb. 1, and placed under the direction of the city engineer to whom the superintendents of water-works and of streets will report. Louis D. Kelsey is now city engineer. The change was made for purposes of efficiency and economy. The population of Raymond in 1920 was 4,260.

Montreal Harbor Commission Is Reorganized

Through a recent reorganization of the Board of Harbor Commissioners of the Port of Montreal, Canada, the former system of individual control of the various departments has been superseded by the concentration of full executive authority in the hands of a general manager. M. P. Fennell, Jr., has been appointed general manager and secretary by Dr. W. McDougall, the new chairman of the harbor commission. The other officers are T. W. Harvie, chief engineer, replacing F. W. Cowie who is appointed consulting engineer, replacing the late Sir John Kennedy; Paul Leclaire, formerly the engineer in charge of buildings, bridges and water supply for the harbor commission, assistant chief engineer; and Capt. J. F. Symons, former deputy harbor master, harbor master.

Mr. Harvie was on the staff of the Clyde Engineering Trust for six years, and then became engineer for Sir Robert MacAlpine and Sons on the construction of the Yorkhill docks. He was appointed assistant engineer of the Montreal Harbor Commission in 1907. He is an associate member of the Institution of Civil Engineers and of the Engineering Institute of Canada.

San Francisco Civil Service Men Volunteer Wage Cut

About 200 employees in the building department of the San Francisco Board of Public Works on Feb. 13 volunteered to accept a cut of 7½ per cent in their wages, effective March 1. The workers include carpenters, cement workers, steam fitters, plumbers and other craftsmen in the building trades.

These men could have continued under the present scale of wages, according to T. A. Reardon, president of the board, who said that funds were available to meet the old scale of wages until July 1 when the board of supervisors will prepare a new budget for the ensuing years. "We have accepted the offer of the men," Mr. Reardon said, "as it shows their willingness to aid the city in its campaign for economy."

Plan Engineers' Building in Denver

A committee has been appointed by the Denver (Col.) Engineering Council to investigate and report on the feasibility of a proposed Engineers Building for Denver. The committee consists of one member from each of the member organizations of the council and is at present considering various plans for financing the project, among which are several co-operative ownership schemes.

It is proposed to submit a questionnaire to the engineers in the vicinity in an endeavor to obtain their opinions regarding the merits of the different plans which have been proposed. The personnel of the joint committee is as follows: W. F. R. Mills (Engineering Council), chairman; Walter L. Drager (Am. Soc. C. E.), R. W. Gordon (Colorado Scientific Society), Fred W. Hart (A.S.M.E.), Richard A. Parker (A.I.M.E.), H. B. Barnes (A.I.E.E.), Ralph J. O'Rourke (Colorado Society of Engineers), secretary.

"No Net Income" Reported by 40% of All Construction Firms

Companies engaged in construction in the United States in 1919 paid a total tax in that year of $67,219,756. The number of companies making returns to the Bureau of Internal Revenue was 8,242. Of that number, 5,927 companies reported a total net income of $162,463,771, the remaining 3,215 companies had no net income and reported deficits aggregating $21,862,285. The number of corporations and the net income for each group were:

Excavation and construction under or upon the ground (not buildings), 919 companies, net income, $5,391,057; jetty, dam, dry-dock, wharf, and bulkhead, 130 companies, net income, $2,875,312; railroad construction, 59 companies, net income, $403,863; shipbuilding, 301 companies, net income, $88,400,530; buildings, 3,049 companies, net income, $22,407,572; equipping and installing machinery and equipment, such as elevators and carrier systems, 1,756 companies, net income, $7,958,418; wrecking, raising or moving (not marine), 94 companies, net income, $556,094; all other construction and contractors, 1,934 companies, net income, $34,470,925.

Market for American Road Machinery in Argentine

The growing interest in the value of serviceable highways throughout Argentina, reports E. F. Feely, U. S. commercial attache at Buenos Aires, will ultimately lead to considerable demand for American road machinery and commercial vehicles. Though little business can be expected at present, owing to the unfavorable exchange situation, Mr. Feely says it is advisable that American manufacturers of road-building machinery and commercial vehicles place literature before the Argentine road engineers. Correspondence of this nature can be addressed to Presidente de la Comision, Primer Congreso de la Vialidad, Touring Club Argentino, Avenida de Mayo 761, Buenos Aires.

Biles Will Be Chief Executive of Penn. Highway Department

Following the death of Commissioner Lewis S. Sadler, it has been announced that George H. Biles, assistant highway commissioner, will direct the affairs of the Pennsylvania State Highway Department. Commissioner Biles joined the staff of the department as chief draftsman in June, 1905, after a service of several years with the Philadelphia Department of Public Works.

In June, 1906, he was made division engineer of the state highway department in charge of the central and a portion of the eastern counties of Pennsylvania and conducted for the state some of the first experiments in bituminous road materials. He was promoted, in 1912, to be assistant to the chief engineer, and a year later became maintenance engineer, organizing the maintenance division and assuming direct charge of all maintenace on state highways and state-aid roads. Mr. Biles was appointed second deputy commissioner in 1915 and three years later, in addition to his supervision of maintenance, was placed in charge of all constructive and administrative work. After Mr. Sadler's appointment Mr. Biles became assistant commissioner.

New Company Plans Airship Lines for Commercial Service

Formation of a corporation to engage in commercial air transportation over regular lines has been announced by the Chamber of Commerce of the United States. It will be known as the General Air Service and numbers among its founders Benedict Crowell, formerly assistant secretary of war; L. V. Benet, president, the Hotchkiss Co.; Owen D. Young, vice-president, the General Electric Co.; Marshall Field, 3d.; Col. Charles De Forest Chandler, U. S. Army, retired; Snowden A. Fahnestock; E. M. Herr, president, the Westinghouse Co.; Samuel McRoberts; R. B. Mellon of the Mellon National Bank of Pittsburgh; Theodore Pratt of the Standard Oil Co.; Franklin D. Roosevelt, Benjamin Thaw of Pittsburgh and David Goodrich of New York.

The General Air Service plans to use dirigible airships of a modified Zeppelin type, fabricated in Germany, and assembled in this country. They are to be of 4,000,000 cu.ft. capacity, inflated with helium, and designed for the use of oil fuel rather than gasoline. It is expected that two of these ships, each with accommodations for 100 passengers and 30 tons of mail and express matter will be plying between New York and Chicago by the summer of 1923.

North Dakota Engineers Hold Two Annual Meetings

Meetings of two engineering associations were held in North Dakota Feb. 8-10. At the annual meeting of the North Dakota Society of Engineers, at Jamestown Feb. 8 and 9, the licensing of architects and engineers was discussed by G. R. Horton, architect. Apart from papers on lignite coal, oil-well drilling, radio and the relation of freight rates to construction work, the more technical papers were:

"Water Supply and Distribution," E. J. Thomas, Minot; "Paving for North Dakota Conditions," E. R. Griffin, Mandan; "Water Purification at Fargo," T. R. Jacobson, Fargo; "Sewer Maintenance at Jamestown with Reference to Imhoff Tanks and Ejector Systems," H. H. Hurning, Jamestown; "Reorganizing of Public Health Work in North Dakota," Dr. H. E. French, Grand Forks. E. R. Griffin, county surveyor, Mandan, was elected president; secretary, Prof. E. F. Chandler, University No. Dak. The next meeting will be held at Mandan in January, 1923.

At the meeting of the North Dakota chapter of the American Association of Engineers, held at Bismarck Feb. 9-10, the papers included:

"American Indian Engineering," M. R. Gilmore; "Land Classification and the Engineer," C. C. Converse; "Experiences of a Highway Engineer," J. A. Wallace, Devil's Lake; "Sewage Disposal at Minot," E. J. Thomas; "Irrigation in North Dakota," C. H. McMahon, assistant state engineer; "The County Superintendent of Highways," T. H. Robinson, Washburn; "The Bismarck-Mandan Bridge," W. H. Robinson, state engineer; "Federal Aid for Highways," S. R. Sharts, U. S. highway engineer; "Proposed Highway Legislation," F. W. Mees, Mandan. The president for 1922 is William Barneck, Bismarck; secretary, W. H. McGraw, state highway commission, Bismarck.

Regional Conference Plan Under Way in Los Angeles County

The Board of Supervisors of Los Angeles County, Cal., has instituted a plan for conferences of representatives from five sections of the county which will consider ways and means of working out solutions of common problems to the best interests of all concerned.

The first meeting was held in Pasadena Jan. 21 with about 100 representatives from various parts of the county present. At this session committee reports were received on highways, subdivisions, parks and boulevards, transportation, garbage and sewage disposal, flood control, zoning and legislation. The next meeting will be in Long Beach about April 1.

U. S. Exposition Building at Rio To Be Built

The contract for the construction of the exposition building to house the exhibits of the United States at the great Brazilian Exposition next September has been awarded to Dwight P. Robinson & Co., which already have large construction work under way for the Brazilian Government in Northeastern Brazil. Representatives of the company and of Frank L. Packard, architect, of Columbus, who will design the building, sailed recently for Brazil to begin the work.

The exposition will open at Rio de Janeiro Sept. 7 and will commemorate 100 years of Brazilian independence. It was recently announced at the White House that the American Building would be of permanent construction and so designed as to permit of its being converted into an embassy for this country's displomatic representative after the close of the exposition.

Engineering Standards Committee Elects Officers

At the adjourned annual meeting of the American Engineering Standards Committee held in New York, Feb. 9, Albert W. Whitney, a representative of the National Safety Council, was elected chairman, and George C. Stone, a representative of the American Institute of Mining and Metallurgical Engineers, was re-elected vice-chairman. Mr. Whitney is associate general manager of the National Bureau of Casualty and Surety Underwriters. A. A. Stevenson, the retiring Chairman, is a representative of the American Society for Testing Materials.

The following were elected to represent the respective member-bodies on the executive committee:

Martin Schreiber, American Electric Railway Association.
Sullivan W. Jones, American Institute of Architects.
C. E. Skinner, American Institute of Electrical Engineers.
E. A. Frink, American Railway Association (Engineering Division).
——— ———, American Society of Civil Engineers.
Eugene C. Peck, American Society of Mechanical Engineers.
John A. Capp, American Society for Testing Materials.
——— ———, Association of American Steel Manufacturers.
A. H. Moore, Electrical Manufacturers Council.
N. A. Carle, Electric Light & Power Group.
Dana Pierce, Fire Protection Group.
A. Cressy Morrison, Gas Group.
Coker F. Clarkson, Society of Automotive Engineers.
Thos. H. MacDonald, U. S. Department of Agriculture.
G. K. Burgess, U. S. Department of Commerce.
O. P. Hood, U. S. Department of Interior.
Francis J. Cleary, U. S. Navy Department.
Beverly C. Dunn, U. S. War Department.

Engineering Societies

Calendar

Annual Meetings

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York; Spring Society Meeting, Dayton, Ohio, April 5-6; Subject, "Flood Problems."

AMERICAN RAILWAY ENGINEERING ASSOCIATION, Chicago; Annual Convention, Chicago, March 14-16.

AMERICAN WATER WORKS ASSOCIATION, New York City; Annual Convention, Philadelphia, May 15-19.

The Engineers' Club of Memphis, Tenn., has elected the following officers for 1922: President, E. H. Bowser; vice-president, M. J. Mallery; secretary-treasurer, Albert S. Fry; directors, A. L. Dabney, C. C. Pashby and W. G. Stromquist.

The New York Section, Am. Soc. C. E. will hold a joint meeting March 15 with the New York Sections of the A. S. M. E., A. I. M. E., and A. I. E. E. The subject for discussion will be the "Port of New York" and the opening address will be delivered by E. H. Outerbridge, chairman of the Port of New York Authority.

The Ohio Engineering Society elected the following officers at its annual meeting: President, Robert N. Waid, chief engineer of maintenance, division of highways, Department of Highways and Public Works, Ohio; vice-president, John N. Leach; secretary-treasurer, John W. Graham.

The Tacoma Chapter, A. A. E. has elected the following officers for 1922: President, Glenn L. Parker; vice-presidents W. D. Smith, O. H. Hallberg, Lloyd Crosby and J. V. Gongwer; treasurer, E. A. White; and secretary, D. J. F. Calkins.

Personal Notes

F. W. BRANIN of Medford, N. J., has been appointed assistant engineer of Burlington County, N. J. He will also continue his private practice.

ALEXANDER MACDONALD, deputy conservation commissioner, has been appointed conservation commissioner and by virtue of this appointment he becomes chairman of the New York Water Power Commission.

A. W. MUIR, of Newton, N. J., has been re-elected president of the New Jersey State Highway Employees' Association.

H. LAWRENCE THACKWELL has accepted the position of designing engineer on the dams and headgates of Wichita (Texas) Water Improvement, District No. 1. Later he will go in the field as resident engineer in charge of structures designed.

S. H. LEISTER, formerly with the Austin Co., Philadelphia, Pa., has been

made structural engineer for Walter H. Rae & Associate Engineers, Tiffin, Ohio.

GEORGE F. WOLFE has resigned as chief designing engineer for the International Steel and Iron Co., Evansville, Ind., to open an office at St. Petersburg, Fla., as consulting engineer on structural steel and reinforced concrete structures.

C. T. HENNING, JR., has resigned as county engineer, Hillsboro, Tex., to accept a position with the state highway department as division engineer, with headquarters at Fort Worth.

ALVORD & BURDICK, consulting engineers, Chicago, announce that the firm will hereafter be known as Alvord, Burdick & Howson. Louis R. Howson whose name is now identified with the firm has been a member of the organization for 15 years, successively as assistant, principal assistant and partner. As in the past, the firm will continue in the practice of problems relating to water-works, water purification, sewerage, sewage disposal, flood relief, drainage, power generation and appraisals.

J. W. JOHNSTON, assistant general manager of the Portland Cement Association, until recently located at the general offices at Chicago, has been transferred to the association's New York office. Mr. Johnston has been with the association for six years and was originally in charge of the district office at Parkersburg, W. Va. From there he was transferred to Wisconsin and put in charge of the Milwaukee district office. Upon his promotion to position of assistant general manager he was transferred to the Chicago office.

G. H. NICKERSON, formerly superintendent of construction in the county engineer's office, Merced County, Cal., has been made chief engineer of the Yosemite Valley R.R. with headquarters at Merced.

WALTER A. SILLYMAN, of the firm of Joseph S. Sillyman Co., mining and civil engineers, Altoona, Pa., has been elected engineer for the Cambria County Commissioners, Ebensburg, Pa.

A. R. LOSH, of the construction division in the Washington office of the U. S. Public Roads Bureau, has been detailed as acting district engineer of the bureau in Texas, succeeding Capt. J. D. Fauntleroy, who has been granted leave of absence to become state highway engineer of Texas.

CHARLES H. MOOREFIELD has resigned as state highway engineer of South Carolina.

DANIEL B. SAYER, who organized and managed the construction department of the Communipaw Co., New York City has resigned, effective Feb. 24. He will continue to engage in building construction.

FRED W. THOMAS has been appointed city engineer of Logan, Utah, succeeding A. H. Chambers, resigned. Mr. Thomas has been assistant city engineer since his return for military service in 1919.

L. G. LENERT, assistant sanitary engineer, U. S. Public Health Service, has been granted leave of absence to serve on the International Health Board during 1922. He will have headquarters in Sacramento, Cal.

FRED J. GRUMM, assistant chief engineer of the county highway commission, San Diego, Cal., and president of the San Diego chapters of the American Society of Civil Engineers and the American Association of Engineers, has been appointed assistant engineer in the headquarters office of the California State Highway Commission.

CHARLES H. MOORE, assistant purchasing agent, Pennsylvania State Highway Department for the past 8 years, has resigned to become secretary and traffic manager of the Associated Pennsylvania Highway Contractors, Harrisburg, Pa., succeeding Charles F. Puff, Jr.

C. A. D. BAILEY & CO. a contracting firm has been organized at Atlanta, Ga. The company will do a general contracting, dredging and engineering business. C. A. D. Bailey, president of the new firm, has had wide experience both in engineering work and in general contracting. He is a former vice-president of the Foundation Co., New York City, and previous to his association with that firm was prominently connected with the J. G. White Engineering Corp., and other New York and London contractors.

BUSINESS NOTES

THE UNITED STATES CAST IRON PIPE AND FOUNDRY CO., Burlington, N. J., has opened a new office at Kansas City, Mo., in charge of D. W. Pratt.

C. L. DEWEY, who was associated with Carl Akeley in the invention and development of the Cement-Gun and who has done extensive Cement-Gun-contract work under the names of the Dewey Cement-Gun Co. and the Traylor-Dewey Contracting Co. of Allentown, Pa. has joined the forces of the Cement-Gun Construction Co. of Chicago, Illinois.

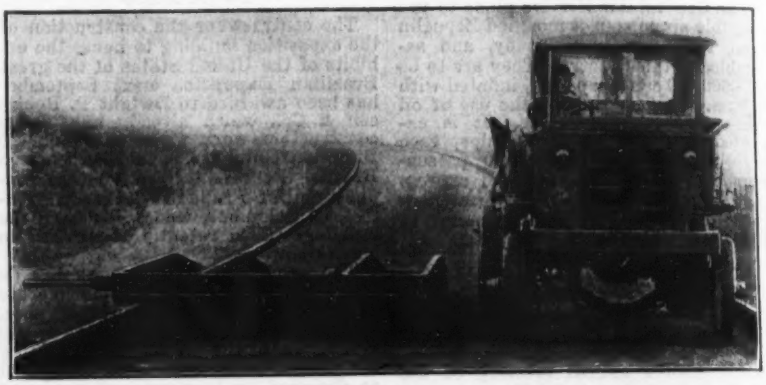
GEORGE S. HEDGE and FREDERIC W. MATTHEIS, dealers in construction equipment, will shortly open offices in Boston, Mass. Both Mr. Hedge and Mr. Mattheis were with Waldo Bros. & Bond, of Boston, for many years. Mr. Hedge has recently been New York sales manager for the Lakewood Engineering Co.

THE CUMMINGS MACHINE CO., INC., Minster, Ohio, announces that the company will hereafter be known as the Industrial Equipment Co., Inc. There will be no change in location, management or personnel of the firm as a result of the change in name.

EQUIPMENT AND MATERIALS

New Motor Truck Turntable

A truck turntable which occupies only one-half the roadway and in turning swings over the side form has been put on the market by the Blaw-Knox Co., Pittsburgh, Pa. Skids, on which it can be hauled, form the base of turntable. A truck after being drawn on the turntable is secured from tipping by supports at each end of the table. When the truck is ready to be turned, a lever is operated which folds up these supports and then acts as a push bar

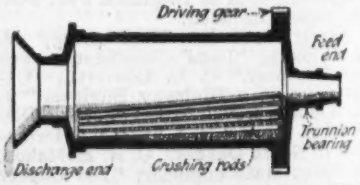


by means of which one man can turn a 5-ton truck loaded with 4 cu.yd.

The runways, which support the truck are mounted on a circular track of less diameter than the width of the truck. This track is placed immediately above a similar circular track which is rigidly secured to the skids. Between these tracks are a series of rollers so that there are no axles to cause friction. A center pin, rigidly secured to the skid which supports the lower track, holds a spider which keeps the rollers in place and also holds a central bearing for keeping the upper track properly centered.

Rod Type Crushing Mill

The Ruth rod mill, for fine crushing, mainly for ore, as manufactured by the Denver Engineering Works, Denver, Colo., consists of a horizontal cylinder having a charge of loose longitudinal rods which crush the material between



them as the cylinder revolves. The size of feed is 1½-in. to 2-in. and the product varies from 20 to 50 mesh. A large discharge opening provides a gravity flow from the feed end. The driving end is provided with a base plate carrying both the trunnion and pinion shaft bearings, this plate having adjusting screws by which the proper alignment of the gears is maintained.

Business Side of Construction

Facts and Events that Affect Cost and Volume

Value February Contracts Is $57,697,345

Practically Equal to Value for Same Month of 1920, Though Lower Than for January

The value of all contracts let as reported in *Engineering News-Record* was, for the month of February, $57,697,345. This figure takes into account the main classes of construction excluding residential building. The figure is about $1,000,000 less than was reported for the corresponding month of 1921. Inasmuch as the cost of building has dropped considerably the past year, the figure for the month just passed represents in volume at least 30 per cent more construction than was put under contract for February, 1921. The value of contracts let for February of 1920 was in excess of $148,000,000, as shown by the accompanying table. As has been the case in the past months, the highest contract value in February was reported for miscellaneous building—churches, theaters, schools, banks and office buildings.

Following is the tabulation of the values contracts let, as reported in *Engineering News-Record* for February of 1920, 1921 and 1922:

Classification	1920	1921	1922
Waterworks	$2,171,725	$2,927,307	$777,341
Sewers	622,874	2,445,075	2,408,123
Bridges	2,137,393	885,529	1,002,035
Excavation, dredging	786,943	305,740	419,034
Streets, roads	21,334,013	12,049,344	10,226,389
Industrial	65,262,290	4,737,859	6,747,972
Buildings	52,200,466	31,902,608	31,434,916
Federal government	2,282,373	1,574,927	735,317
Miscellaneous	3,466,519	1,728,441	3,946,218
Total	$148,264,596	$58,556,821	$57,697,345

Labor Distribution on House Construction Studied

According to a recent investigation carried on by the Division of Building and Housing of the Department of Commerce, wages paid to carpenters represent practically half of the entire labor cost on a frame house and 32 per cent in a brick house. The cost of other classes of labor on a frame house is as follows: Bricklayers, 6.2 per cent; hod carriers, 2.2 per cent; plasterers, 7.9 per cent; plumbers, 8.7 per cent; electricians, 2.6 per cent; painters, 10 per cent; common laborers, 6.3 per cent; and all others, 6.5 per cent. For a brick house the following cost distribution is made according to the various classes of workers: Carpenters, 32.2 per cent; bricklayers, 21.5 per cent; hod carriers, 6.7 per cent; plasterers, 8.8 per cent; plumbers, 7.6 per cent; electricians, 2.5 per cent; painters, 6.3 per cent; common laborers, 9.9 per cent; and all others, 4.5 per cent.

Averages were made from reports covering a large number of six-room brick and frame houses throughout the United States.

January Distribution of Contracts in U. S.

Contracts Classified Geographically and by Kind of Construction

Amount of construction in prospect can be gaged by the value of contracts being awarded. Contracts let in the last quarter of a year give an idea of the volume of construction to be expected in the following spring. These data were presented geographically on p. 174, Jan. 26 issue. The January figures are now available in Table I.

Contracts let on all classes of engineering construction since Oct. 1, 1921, to Feb. 1, 1922, aggregated $380,000,000, according to Construction News. Only those contracts are included which exceed $25,000 in the case of public work, $40,000 for industrial works and $150,000 for buildings.

The January total for the country is $78,550,953, distributed geographically as follows: Mid-West, 25 per cent; South, 23; Middle Atlantic, 20; West of Mississippi River, 14; Far West, 14; New England, 4. A particularly hopeful sign is that more industrial con-

Engineering News-Record Construction Cost Index Number

March, 1922	162.04
February, 1922	168.72
March, 1921	224.27
Peak, June, 1920	273.80
1913	100.00

Engineering News-Record's Construction Cost Index Number is 6.68 points lower than for the last two months, due to declines in steel, cement and labor. Lumber remained firm. Steel now sells for $1.40, Pittsburgh. Cement prices are down slightly in the Middle West. Average hourly rate for common labor over the country is 43c., as against 45c. since Nov. 1, 1921. Thus, general construction cost is 28 per cent cheaper than one year ago and 38 per cent under the peak; it is 62 per cent above the 1913 level.

Engineering News-Record Construction Volume Index Number

Monthly

February, 1922	100
January, 1922	91
February, 1921	43
1913	100

Yearly

1921 (entire year)	88
1920 (entire year)	91
1913	100

Engineering News-Record's Construction Volume Index Number is 100 for the month of January, and 88 for the whole of 1921, as against 100 for 1913. This means that the actual volume of construction in 1921 (not the mere money value of the contracts let that year) is 12 per cent under the volume of construction for 1913. Our monthly volume number, 100 for February, 1922, is really the increment of construction, and indicates the rate at which contracts are being let as compared with 1913 awards.

TABLE I—VALUE OF CONTRACTS LET IN THE UNITED STATES IN JANUARY, 1922

	New England	Middle Atlantic	Southern	Middle West	West of Miss.	Western	Total
Water-Works	.....	$191,000	$230,000	$597,000	$327,000	$452,000	$1,797,000
Sewers	.....	1,271,000	27,000	322,000	45,000	110,383	1,775,383
Bridges	$175,000	1,778,000	171,000	344,000	456,000	70,000	2,994,000
Excav. and dredging	.....	25,000	178,000	.....	.....	284,000	487,000
Streets and roads	444,000	2,257,000	4,056,000	2,372,000	3,251,000	2,044,000	14,424,000
Industrial wks	550,000	2,884,000	12,355,000	1,408,000	365,000	350,000	17,912,000
Buildings	1,867,000	6,599,000	886,000	14,131,000	3,611,000	6,052,000	33,146,000
Fed. gov't. wk	8,500	261,000	39,000	.....	.....	866,000	1,174,500
Miscellaneous	.....	570,000	36,800	743,810	3,070,460	420,000	4,841,070
	$3,044,500	$15,836,000	$17,978,800	$19,917,810	$11,125,460	$10,648,383	$78,550,953

struction was contracted for in January, 1922, than in any month of 1921. Contracts for industrial work in January, 1921, amounted to $12,882,000; January, 1920, $56,000,000; 1913, $2,000,000.

Table II presents F. W. Dodge Co.'s statistics of residential contracts awarded in January, 1922, in the Northeastern quarter of the United States.

TABLE II—RESIDENTIAL CONTRACTS LET IN JANUARY, 1922.

District	Number Projects	Floor Space in Sq. Ft.	Value
Boston	519	1,263,800	$5,090,100
New York	870	8,027,700	35,329,700
Philadelphia	631	3,586,200	12,849,400
Pittsburgh	572	1,970,700	7,966,500
Chicago	667	2,984,100	13,558,300
Minneapolis	151	250,300	934,300
Total	3,410	18,082,800	$75,728,300

The total valuation of contracts let on all classes of construction in the United States in January, 1922, is probably $300,000,000.

California Comment on Uniform Cement Prices

Commenting upon the resolution taken by executive officers of eight Mid-West states not to make any contracts for highway construction involving the use of cement until prices are reduced, the Feb. 2 Bulletin of the California Highway Commission remarks that "the price of cement at present made to the California Highway Commission by all the northern mills in California is $2.35 per bbl., mill base, the mills all quoting the same delivered price and absorbing any freight differentials due to differences in distances from delivery points. Among the mills of Southern California, however, a limited competition exists and the mill base price there is appreciably lower.

"Before the war the California Highway Commission enjoyed a range of price from $1.04 to $1.40 per bbl. mill base. The peak price on account of war time conditions was $2.70 on Sept. 2, 1920. It has since dropped to $2.35 but is still fully $1 per barrel above pre-war prices.

"Informal bids were received from the Northern Cement Companies by the California Highway Commission last week. On 3,000 bbl. for delivery at Suisun-Fairfied all companies bid $2.52 per bbl. On 375 bbl. for delivery at Sacramento all companies bid $2.69. On 232 bbl. for delivery at Altamont all companies bid $2.78.

Freight Traffic on French Railways

During the first 11 months of 1921, the average number of freight cars loaded daily on French railways, including Alsace-Lorraine, according to Commercial Attaché W. C. Huntington, Paris, was as follows:

January	38,434	July	39,607
February	40,137	August	43,087
March	38,679	September	47,191
April	40,266	October	48,956
May	39,000	November	48,931
June	41,590		

On account of the increased average weight per carload, 40,000 loaded freight cars at the present time are equivalent in tonnage to 60,000 pre-war freight cars.

Uniform Prices Inevitable, Says Cement Man

Competition, Not Collusion, Forces Bids to Same Level, Is Statement of Universal President

In the issue of Jan. 19, p. 25 (Construction News) *Engineering News-Record* reproduced the tabulation of bids for furnishing the Wisconsin Highway Department with cement. Uniformity of the bids submitted by four manufacturers led to a request that the situation be explained, as a natural inference might be the existence of an agreement on price among the various cement producers who bid. The following letter from B. F. Affleck, president of the Universal Company, explains the situation in detail—

"There is no collusion. Such uniformity of prices as appears in this list of bids and elsewhere is due not to collusion, but to competition. Cement is a standard commodity conforming to a standard specification adopted by the government, the engineering profession, and cement manufacturers generally. There is no substantial variation in quality. It must all conform to standard specifications and is not required to exceed these specifications. The freight rates on cement, which is a large percentage of the value of the material, are matters of record. The railroads cannot vary them except on notice. The product, being one which is sold to many thousand dealers and consumers, is offered freely by the manufacturers at prices which are not secret, but which are given wide publicity.

"The material is made in a factory which the owner tries to operate continuously with perhaps some seasonal shutdown. He can determine in advance with fair accuracy his manufacturing costs and these do not vary widely except as wage rates and cost of fuel and material advance or decline. Therefore, changes in prices are as a rule infrequent. When prices change, most of the manufacturers notify by circular their customers and others whose business they desire of the new prices.

Quotation Basis Easily Figured

"The conditions recited above make it easy for any given manufacturer by simple arithmetic to ascertain the basis of quotations made by any other manufacturer. In fact, as the cement business is and must be conducted, it is quite impossible for any manufacturer to keep secret his policy with respect to prices. The price at a given destination is made based on a mill price, plus freight. It has been shown above that this mill price or basis quickly becomes a matter of common knowledge. The freight rate also is well known. Therefore it is easy to determine the delivered price. The material being a standard commodity throughout the country, it is practically impossible for any manufacturer to get more for his product delivered at destination than any other manufacturer who can make the delivery is asking at the point of delivery. It is also not to be expected that a manufacturer, knowing what the market is at a given destination, will offer his product at less than that market. Were he to do so the strong probability is that the lower quotation made by him would soon establish itself as the market price and he would find himself obliged to sell all of his product at the lowered market price. And, of course, other manufacturers would also sell at this lowered price, which would quickly again become uniform as between all manufacturers quoting at the same destination.

"It may be assumed that the public has no objection to uniformity of prices unless these prices are too high. If the cement manufacturers were to quote prices only at their mills instead of quoting delivered prices, the effect would be that at most destinations there would be only one brand of cement obtainable at the low price, prices on other brands from more remote mills being higher. This would clearly be a non-competitive condition which would not be to the advantage of the consuming public, but decidedly to its disadvantage.

"In the case of Waukesha, listed in the table of bids referred to, the Universal Company's bid was based on $1.60 at Buffington, the price in effect since Sept. 15, 1921, with 40c. for sacks, and 48c. per barrel freight. This makes $2.48 delivered at Waukesha. Other cement companies, knowing what base price Universal had used since Sept. 15, assumed that its bid at Waukesha would be $2.48 and they could not expect Waukesha business if they bid higher. Therefore the Lehigh and Alpha Companies, whose mills are at La Salle, Ill., with a freight rate of 53c., shrunk the net at their mill to $1.55 to meet Universal competition and the Sandusky Cement Co. whose mill is at Dixon, Ill., with a freight rate of 51c., reduced the net price at its mill to $1.57 to meet Universal competition."

Trend of Business

Bonds — Light issues, active demand, rising quotations. New York Transit Commission set valuations on the local traction properties of about half their book values, which caused a temporary decline in securities of the companies. Foreign government list was feature of the bond market, the activity following the mounting of exchange rates.

Foreign Exchange — Highest in three years. Sterling $4.43¼ ($4.86⅔ is par).

Net earnings of well known companies compared for 1921 and 1920 are a good index of industrial conditions:

New York Shipbuilding Corporation $2,046,559 in 1921, against $2,395,402 in 1920.

Atlas Powder Co. $634,484 or $1.71 per share of common stock in 1921 against $1,434,693 or $16.32 per share in 1920.

American Locomotive Co. $3,333,785 or $13.34 per share in 1921 against a 1920 showing of $5,361,126 or $21.44 a share.

National Lead Co. were $3,481,512 in 1921, compared with $4,755,508 in 1920.

Restrictive Trade Practices Barred by Federal Court

As a result of a conference held Feb. 24 at the office of the United States Attorney-General between representatives of the Department of Justice and those of the International Organization of Bricklayers, Masons and Plasterers, the executive heads of the union have executed a consent to the entry of a court decree in the United States District Court for the southern district of New York which eliminates certain objectionable trade practices. The decree directs (1) that no limit be set upon the productive capacity of the individual workman; (2) that no limit be placed upon the right of the employer to purchase his materials, whether those materials are union made or not; (3) that no favoritism be shown by organized labor toward employers or trade associations or contractors' associations and that no discrimination be allowed as between members and non-members of such associations; and (4) that labor organizations are not to be used as agencies for the collection of alleged claims by material men, contractors or subcontractors. The decree becomes a constitutional provision of the trade union involved.

Restrictions upon individual output is considered a strictly war-period development and has been condemned by the executive heads of the trade associations involved. The decree is therefore directed against any concerted effort at curtailment of production, though it does not at all prohibit the regulation of hours or conditions of labor.

The second of the principles enunciated in the decree is directed against a certain practice which may be typified

Labor Rates and Conditions Throughout the Country

Of the twenty one cities reporting, thirteen show changes in industrial conditions and only three report actual changes in labor rates. Common labor rates vary from 20c. per hour in the South and in Montreal to 35@50c. elsewhere. The average for the entire country is 43c., against 45c. for the preceeding four months. Hoisting engineers are receiving 87c. as against 87½c. per hr. in Baltimore. Montreal pick and shovel men for excavating work are quoted at 20c.@25c. as compared with 20c.@30c. per hr. one month ago. While the regular St. Louis union scale of 67½c. per hr. for common labor has nominally remained in force, non-union, unskilled common labor is now obtainable at a rate as low as 30c.

Los Angeles reports all classes of work held up this month on account of heavy rains and unsettled weather conditions. Despite this, unemployment, particularly in the common labor class, has shown a slight decrease. As soon as the weather permits, increased construction activity is looked for.

Current labor rates in Cincinnati will remain in force until May 1, when readjustments are expected. Not fewer than 70 per cent of the city's skilled mechanics and 30 per cent of the common laborers are at present employed.

A condition of alternating strikes and lockouts, existing in Philadelphia during 1921, has finally subsided and the builders do not anticipate difficulties for the spring months. Bricklayers, masons and plasterers have returned to work and conditions favor increased construction activities during 1922.

Denver reports a slight increase in the number of employed workmen, but conditions are still far below normal.

Employment in all trades in Detroit shows a slight increase over last month. Favorable weather has permitted uninterrupted construction work on projects started during the winter.

The Minneapolis Board of Park Commissioners has voted a reduction in the common labor rate from $4.50, the rate paid last year, to $4, for eight hours. The common labor rate in all departments under control of the City Council is $5 per day, by ordinance, and is unaffected by the action of the Park Commission. The common labor rate on work other than municipal is 40c.@50c. per hr.

Steamfitters in Syracuse have agreed to a wage cut from $1.12½ to $1.05 per hr., but hoisting engineers and journeymen plumbers have thus far successfully resisted wage reductions.

Cement finishers in St. Louis have accepted a wage reduction from $1.25 to $1 per hr., effective March 1.

Satisfactory adjustments in the building trades' wage scale for the coming season, in Duluth, have stimulated considerable interest in building projects in that section.

Current labor rates in Cleveland were to have expired by agreement on Mar. 1, but negotiations thus far have not produced definite results.

In Chicago, carpenters, plumbers, hoisting engineers, cement finishers, lathers, fixture hangers, sheet metal workers, roofers and laborers' unions have all been refused recognition by the Citizens' Committee to enforce the wage award made by Judge Landis on Sept. 7, 1921. Meanwhile, Judge Landis has resigned as arbitrator of the building trades controversy. The Committee will retain all non-union men now employed and also all union men who sign a pledge to abide by the award and not to strike.

In comparison with other parts of the country, construction work in the New York district has been fairly active all winter and the spring season is expected to witness even a greater activity. San Francisco also reports increased building operations as well as a visibly increased interest in prospective construction.

Labor plentiful, all classes.—Higher rates indicated by +, decreases by—

Cities	Bricklayers	Carpenters	Hoisting Engineers	Hod Carriers	Pile Drivers	Structural Iron Workers	Common Labor
Atlanta	$0.90	$0.70	$1.00	$0.30	.....	$1.00	$0.20@.25
Baltimore	1.25	.80	— .87	.54	$0.74	1.00	.30
Birmingham	1.00	.75	.....	.25	.....	1.00	.15@.25
Boston	.90	.75	.90	.60	.90	.90	.40
Cincinnati	1.25	.95	.95	.72½	.77½	.95	.40
Chicago	1.10	1.00	1.10	.....	.....	1.05	.35@.40
Cleveland	1.04	1.04	1.04	.60	.91	1.04	.57½
Dallas	1.00	1.00	1.00	.60	1.00	1.00	.35@.45
Denver	1.37½	1.00	1.00	.75@.81¼	1.00	1.00	.35@.40
Detroit	1.00	.80	.80@.90	.50@.60	1.00	.60@.80	.50
Kansas City	1.07½	1.00	1.00	.80	1.07½	1.07½	.70
Los Angeles	1.25	1.00	1.00	1.12½	.87½	1.00	.50@.56¼
Minneapolis	1.00	.80	.80	.65	.....	.80	.40@.50
Montreal	.80	.60	.50	.30	.50	.50	—.20@.25
New Orleans	1.00	.88	.90	.40	.80	1.00	.30
New York	¼.25	1.12½	1.25	.87½	1.00	1.12½	.60
Pittsburgh	1.12½	1.00	1.00	.80	1.00	1.00	.40@.45
St. Louis	1.25	1.25	1.25@1.37½	.85	1.25	1.25	—.30
San Francisco	1.12½	1.00	1.00	.75	1.00	1.12½	.47½@.56
Seattle	1.00	.80	.90	.70	1.00	.80@.90	.50
Philadelphia	1.00	.90	.90	.75@90	1.00	.90	.50@.60

by the fact that in construction work in many of the larger cities labor unions have required that stone be imported in the rough and dressed and finished locally by union labor. The contractor may now purchase his material when, where and from whomever he chooses. It is the belief of the Department of Justice officials that this practice has constituted one of the most potent factors in the high cost of building, and the consequent shortage of housing and large rent increases.

The Department has found many instances wherein a labor organization would, for some bonus or other inducement, agree to grant preference or to furnish some co-operation to the trade association member as against his independent competitor. Numerous cases of the kind were also brought out in the investigations carried on by the Lockwood Committee in New York City. It is against this apparent collusive agreement between labor organization and trade association member that the third of the principles is directed.

Instances have been reported to the department from both Chicago and New York to the effect that contractors and builders have used labor unions as instruments for collection of their debts. For instance, the practice prevailed in certain centers wherein members of labor unions refused to work on the completion of a job although fully compensated for their work and assured of future compensation, merely because some previous owner of the building had defaulted in a payment to some material man. In one case in New York a collection system was used wherein payment for the same claim was extorted two or three times. Threats that the dealer could not secure the labor to complete or finish his job if he did not pay usually had the desired effect.

In its investigation of the masons, bricklayers and plasterers international union the Department of Justice did not feel justified in proceeding to indictment, but believed that the same results could be obtained by the issuance of the decree herein outlined.

Car Surplus, Shortage and Freight Loading

Plenty of freight cars are available, as shown by the table which *Engineering News-Record* has arranged from the latest summary of car surplusages and car shortages compiled by the American Railway Association. The "shortage" columns indicate both that there is no car shortage and that business is light. On the other hand, the surplusage has been decreasing steadily with continued increase of freight loadings.

Loading of revenue freight totaled 788,412 cars during the week which ended on Feb. 11, an increase of 34,526 cars over the week before, according to reports just received from the railroads of the United States by the Car Service Division of the American Railway Association. This was 100,545 cars in excess of the total for the corresponding week in 1921 and 1,779 more than loaded during the corresponding week in 1920.

The increase over the week before was due principally to greater shipments of merchandise and miscellaneous freight which includes manufactured products, as well as of coal and grain and grain products, although appreciable gains were also reported in shipments of live stock and forest products.

Loadings of merchandise and miscellaneous freight totaled 445,581 cars, an increase of 15,876 over the week before and 42,018 more than the corresponding week last year. It was, however, 4,448 cars below the total for the same week in 1920.

SURPLUS AND SHORTAGE STATEMENT — FEB. 1 to 8, 1922

Districts	Box Cars — Surplus	Box Cars — Shortage	All Coal Cars — Surplus	All Coal Cars — Shortage	Total All Cars — Surplus	Total All Cars — Shortage
Eastern	23,272	157	35,981	...	63,674	199
Allegheny	22,650	...	61,159	...	88,322	0
Pocahontas	1,395	...	1,437	...	4,455	0
Southern	17,372	...	8,017	...	32,515	11
Northwestern	21,967	...	3,208	...	35,623	15
Central Western	23,438	229	9,146	30	51,552	260
Southwestern	11,434	42	4,171	...	20,518	42
Total	121,528	428	123,119	30	296,659	527
Canadian Roads	29,025	...	1,325	...	42,844	0
Grand total	150,553	428	124,444	30	339,503	527
Jan. 8, 1922	219,345	13	220,774	45	538,387	219

Monthly Prices of Construction Materials

Ups and Downs of the Market

Pig Iron—Average drop of $1 per gross ton in Cincinnati, New York, Birmingham,, Philadelphia, Chicago and Pittsburgh markets. Firmer tone due to increased demand.

Railway Supplies—Slight reduction in light rails f.o.b Pittsburgh. Advance of 12c. per tie on Douglas fir cross-ties in San Francisco. Standard spikes down in Pittsburgh and Chicago; spikes and track bolts down in St. Louis.

Pipe—Advance of two points in wrought steel pipe discounts in Chicago and 3 points in St. Louis. Cast-iron pipe down $2 per ton in San Francisco and Birmingham; slight advances in New York and Chicago. Cast-iron pipe demand fairly heavy. Sewer pipe up 2c. per ft. in St. Louis; slight drop in Denver and Atlanta.

Roads and Paving Materials—Road oils down ½c. per gal. in New York to encourage approaching seasonal demand. Asphalt in package up $5 in St. Louis and $10 in Cincinnati; down $5 per ton in Denver. Asphalt in bulk up 50c. in San Francisco and Philadelphia; $6 in St. Louis and $11 per ton in Cincinnati. Granite paving block down 46c. per sq.yd. in Cincinnati; advance of $5 per M. on basalt blocks in San Francisco. Flagging and bluestone curbing quiet with anticipated upward trend. Wood paving blocks 3 in., down 5c. and 4 in., down 1c. per sq.yd. in New York. Size 3½ in., down 1c., in Baltimore and 4 in., down 30c. per sq.yd. in Cincinnati.

Sand, Gravel and Crushed Stone—Gravel down 20c. in St. Louis and 25c. in Boston; up 15c. per cu.yd. in Los Angeles. Sand down 10c. per ton in Atlanta; up 19c per cu.yd. in Cincinnati and 15c. per ton in Los Angeles. Crushed stone down 10c. in Atlanta; advances 15c. in Los Angeles.

Lime—Hydrated finishing lime is quoted in New York at $15.80@$16.80 as against $16.80 per ton and common lump lime at $2.75@$3.48 as compared with $3@$3.48 per bbl. (280-lb. net) one month ago. Hydrated finishing lime up $1 in St. Louis and $2.75 in Detroit; down $3.30 in Cincinnati, $6 in Denver and $1 per ton in Atlanta. Hydrated common lime advance $1 in St. Louis and $2.75 per ton in Detroit. Common lump lime down 25c. per bbl. (180-lb. net) in Dallas, Denver and Atlanta; up $6.50 per ton in Detroit.

Cement is quoted in New York at $2.30 as against $2.20@$2.30 per bbl. one month ago. Reduction of 3c. per bbl. in Chicago and Cincinnati, 5c. in Milwaukee and 15c. in Peoria, Cedar Rapids and Davenport.

Structural Material—Steel shapes, plates and bars quoted at $1.40@$1.50, Pittsburgh, but $1.40 per 100 lb. accepted on even comparatively small tonnages. Steel shapes quoted at $2.72½ as against $2.97½ in St. Louis warehouses; reinforcing bars ½ in., $2.50, compared with $2.87 per 100 lb. one month ago. Drop of $2 per 100 yd. in expanded metal lath in St. Louis; also a decrease of 25c. per 100 lb. in structural rivets and an advance of 16c. per keg on wire nails. Steel sheets down 15c. per 100 lb. in San Francisco warehouses; slight declines in St. Louis.

Prepared Roofings — Slate-surfaced roofing (red and green) advance 5c. per roll; slate finished shingles up 10c. per square in Philadelphia.

Lumber—Douglas fir No. 1 common down $2 in San Francisco; long leaf yellow pine drops $1 per M. ft. b.m. in Chicago. Slight advances in pine lumber, base sizes, in Atlanta; down in Baltimore. Fir up $3 in Los Angeles and Seattle. Hemlock advances $3 in Los Angeles and $1 per M. ft. in Minneapolis. Fluctuations in Douglas fir market caused by heavy Asiatic shipments as well as domestic demand.

Scrap—Dealers' selling prices on all iron and steel scrap except re-rolling rails, show decline in St. Louis. New York and Chicago prices unchanged.

Manila Rope—Advance of 1c. in Chicago and decrease of 2c. per lb. in Atlanta.

Linseed Oil—Rapid rise in flaxseed market reflected in raw linseed oil prices throughout the country. New York quotes 87c. as against 77c. and Chicago 91c. as compared with 80c. per gal. (5 bbl. lots) one month ago.

Price advances since last month are indicated by **heavy type**; declines by *italics*

PIG IRON—Per Gross Ton—Quotations compiled by The Matthew Addy Co.:

	Current	One Year Ago
CINCINNATI		
No. 2 Southern (silicon 2.25 @ 2.75)	*$20.50*†	$32.00
Northern Basic	*21.02*†	29.50
Southern Ohio No. 2 (silicon 1.75 @2.25)	*22.52*†	32.00
NEW YORK, tidewater delivery		
Southern No. 2 (silicon 2.25@ 2.75)	*26.26*†	37.76
BIRMINGHAM		
No. 2 Foundry (silicon 2.25 @ 2.75)	*16.00*†	27.50
PHILADELPHIA		
Eastern Pa., No. 2X, (2.25@ 2.75 sil.)	*21.76*†	31.54*
Virginia No. 2 (silicon 2.25 @ 2.75)	*27.74*†	55.14*
Basic	*19.84*†	29.00†
Grey Forge	*21.50*†	29.75*
CHICAGO		
No. 2 Foundry Local (silicon 1.75 @ 2.25)	*20.00*†	28@29
No. 2 Foundry Southern (silicon 2.25 @ 2.75)	*22.67*†	35.42
PITTSBURGH, including freight charge from the Valley		
No. 2 Foundry Valley (silicon 1.75 @ 2.25)	*21.96*†	29.96
Basic	*19.96*†	26.96
Bessemer	*21.46*†	28.96

*F.o.b. furnace. † Delivered

RAILWAY SUPPLIES

STEEL RAILS—The following quotations are per ton f.o.b. Pittsburgh and Chicago for carload or larger lots. For less than carload lots 5c. per 100 lb. is charged extra:

	Pittsburgh Current	Pittsburgh One Year Ago	Birmingham	Chicago
Standard bessemer rails	$40.00	$45.00	.....	$40.00
Standard openhearth rails	40.00	47.00	$40.00	40.00
Light rails, 8 to 10 lb	*28.00@30.00*	2.45@3.00*	1.60*	1.65@1.80*
Light rails, 12 to 14 lb	*28.00@30.00*	2.41@2.95*	1.60*	1.65@1.80*
Light rails, 25 to 45 lb	*28.00@30.00*	2.32@2.85*	1.60*	1.65@1.80*
Rerolled Rails	1.45@1.50*	.....	.....	.....

*Per 100 lb.

RAILWAY TIES—For fair-sized orders, the following prices per tie hold:

	6 In. x 8 In. by 8½ Ft.	7 In. x 9 In. by 8½ Ft.
Chicago, White Oak	$1.35	$1.50
Chicago, Hardwood and Red Oak	1.20	1.30
Chicago....Empty Cell Creosoting (add'l)	.45	.50
San Francisco..... Green Douglas Fir	.85	1.10
San Francisco, Empty Cell Creosoted, Douglas Fir	1.86	2.30
St. Louis, White Oak*	1.10	1.30
St. Louis, Red Oak*	.97	1.17

*Standard specifications 38c. per tie additional. Zinc chloride process 27c. per tie additional.

TRACK SUPPLIES—The following prices are base per 100 lb. f.o.b. Pittsburgh for carload lots, together with the warehouse prices at the places named:

	Pittsburgh Current	Pittsburgh One Year Ago	Chicago	St. Louis	San Francisco	Birmingham
Standard spikes, ⅜-in and larger	*$2.20@2.25*	$3.65@3.90	*$2.55*	*$3.47½*	$4.25	$3.25
Track bolts	3.25	5.50@6.00	3.65	4.47½	5.25	4.60
Standard section angle bars	2.40	2.75@3.75	2.40	3.25	4.00	3.45

PIPE

WROUGHT PIPE—The following discounts are to jobbers for carload lots on the latest Pittsburgh basing card:

BUTT WELD

Inches	Steel Black	Steel Galv.	Inches	Iron Black	Iron Galv.
to 3	71	58½	⅛ to 1¼	44½	29½

LAP WELD

2	64	51½	2	39½	25½
2½ to 6	68	55½	2½ to 6	42½	29½
7 to 8	65	51½	7 to 12	40½	27½
9 to 12	64	50½			

BUTT WELD, EXTRA STRONG, PLAIN ENDS

⅛ to 1¼	69	57½	⅛ to 1¼	44½	30½
2 to 3	70	58½			

LAP WELD, EXTRA STRONG, PLAIN ENDS

2	62	50½	2	40½	27½
2½ to 4	66	54½	2½ to 4	43½	31½
4½ to 6	65	53½	4½ to 6	42½	30½
7 to 8	61	47½	7 to 8	35½	23½
9 to 12	55	41½	9 to 12	30½	18½

STEEL—From warehouses at the places named the following discounts hold for steel pipe:

	Black New York	Black Chicago	Black St. Louis
1 to 3 in. butt welded	66%	*62½%*	59%
2½ to 6 in. lap welded	61%	*59½%*	56%

	Galvanized New York	Galvanized Chicago	Galvanized St. Louis
⅛ to 3 in. butt welded	53%	*48½%*	45%
2½ to 6 in. lap welded	47%	*46½%*	42%

Malleable fittings, Class B and C, from New York stock sell at list less 10%. Cast iron, standard sizes, *32-5%* off.

CAST-IRON PIPE—The following are prices per net ton for carload lots:

	New York Current	New York One Year Ago	Birmingham	Chicago	St. Louis	San Francisco
4 in.	$50.50	$73.30	*$37.00*	$46.60@48.10	$46.20	*$52.00*
6 in. and over	47.30@48.30	63.30	*33.00*	42.60@44.10	43.20	*48.00*

Gas pipe and Class "A," $4 per ton extra; 16-ft. lengths, $1 per ton.

CLAY DRAIN TILE—The following prices are per 1000 lin.ft.:

Size, In.	New York Current	New York One Year Ago	St. Louis	Chicago	San Francisco	Dallas
3	$40.00	$50.00	.....	$50.00	.....	$55.00
4	50.00	60.00	*$80.00*	60.00	$90.00	65.00
5	80.00	90.00	.....	80.00	115.00	84.00
6	100.00	115.00	140.00	100.00	150.00	110.00
8	150.00	185.00	200.00	150.00	250.00	181.00

SEWER PIPE—The following prices are in cents per foot for carload lots f.o.b.:

Size, In	New York Delivered	Pittsburgh	Birmingham	St. Louis	Chicago	San Francisco	Dallas
3	$0.14	$0.087	.....	$0.10	$0.12	$0.12	.....
4	.16	.087	$0.09	.10	.12	.15	$0.18
5	.21	.1305	.....	.14	.18	.18	.165
6	.21	.1305	.135	.14	.18	.21	.25
8	.35	.203	.225	.255	.28	.30	.35
10	.52	.3045	.....	.315	.42	.42	.....
12	.67	.3915	.3825	.405	.54	.54	.80
15	1.15	.522	.5625	.585	.72	.90	.....
18	1.55	.725	.765	.765	1.00	1.32	.....
20	1.98	.87	1.125	.....	1.20	.....	.....
22	2.64	1.16	.....	.....	1.60	.....	.....
24	2.97	1.305	1.4625	1.35	1.80	2.16	2.40
27	4.50	1.885	.....	2.25	3.75	3.00	.....
30	5.00	2.088	3.20	2.70	4.75	3.60	.....
33	6.55	2.61	.....	3.35	5.50	.....	.....
36	7.50	2.9725	.....	3.65	6.00	.....	.....

	3	5	8	12	24	36
Boston	$0.108	$0.162	$0.252	$0.486	$1.62	$4.92
Minneapolis	.....	.....	.40	.77	2.55	5.66
Denver	.135*	.18*	*.27*	*.47*	*1.70*	.....
Seattle	.145	.....	.36	.72	2.59	.....
Los Angeles	.11*	.165*	.275	.495	1.65	.....
New Orleans	.....	.108	.27	.459	1.755	.....
Cincinnati	.10	.15	.233	.45	1.50	4.305
Atlanta	*.078**	*.117**	*.195*	*.3315*	*1.8675*	.....
Montreal, *delivered*	.30*	.45*	.70*	1.35	4.50	6.50
Detroit	.105	.1575	.245	.4725	2.115	5.4325
Baltimore	.1225	.2275	.35	*.6870*	2.29	*6.88*
Kansas City, Mo	.15*	.21*	.335	.60	2.41	4.74
Philadelphia	.085	.13	.20	.3925	1.305	3.65

*4-in., 6-in., 9-in., respectively.

ROAD AND PAVING MATERIALS

ROAD OILS—Following are prices per gallon in tank cars 8,000 gal. minimum f.o.b. place named:

	Current	One Year Ago
New York, 45% asphalt (at terminal)	*$0.05*	$0.08
New York, 65% asphalt (at terminal)	*.046*	.07½
New York, binder (at terminal)	*.06*	.08½
New York, flux (at terminal)	.05½	.07½
New York, liquid asphalt (atterminal)	.06	.09
St. Louis, 40-60% asphalt (*f.o.b.*) *Tulsa, Okla.*	.02½	.11
Chicago, 40-50% asphalt	.05	.08½
Chicago, 60-70% asphalt	.05½	.08½
Dallas, 40-50% asphalt	.10	.10
Dallas, 60-70% asphalt	.13	.13
Dallas, 75-90% asphalt	.15	.15
San Francisco, binder, per ton	13.00†	15.00

* Freight $21.75 per ton to Whiting, Ind.
† F.o.b. Oleum, Cal. Freight to San Francisco, 80c. per ton.

ASPHALT—Price per ton in packages (350-lb. bbl., or 425-lb. drums) and in bulk in carload lots:

	Package	Bulk
New York (Bayonne, N. J.)	$25.00	$15.00
Boston	No quotations	
Chicago	25.85	19.50
San Francisco, *f.o.b. refinery*, Oleum, Cal.	19.50*	13.50*
Dallas	35.00	27.00
Seattle	25.40	18.90
Denver	40.00	
Minneapolis		20.50
St. Louis	30.00	25.00
Baltimore	25.00	20.00
Los Angeles, *at factory*	22.50	15.00
Montreal	28.00	21.00
Atlanta	27.00	
Detroit (petroleum asphalt)	24.50	20.00
Cincinnati	36.00	12.00
Maurer, N. J. (natural asphalt)	36.00	33.00
Maurer, N. J. (artificial asphalt)	22.00	20.00
Philadelphia	24.00	17.50
Kansas City	28.83	22.83

*Freight to San Francisco, 80c. per ton.

NOTE—Barrels or drums are optional in most cities. About 6 bbls. to the ton, and from 4 to 5 drums. Rebates of about $1 per bbl., no rebate for drums.

PAVING STONE—

New York	5-in. granite, 28@29 blocks per sq.yd.	$130.00	per M
Chicago	About 4x8x4 dressed	3.35	sq.yd.
	About 4x8x4 common	3.00	sq.yd.
San Francisco	Basalt block 4x7x8	70.00	per M
Boston	5-in. granite	125.00	per M
Atlanta	Granite	2.00	sq.yd.
Detroit	Granite, 26½ blocks per sq.yd.	3.05	sq.yd.
Baltimore	Granite	2.00	sq.yd.
Montreal	Granite	125.00	per M
New Orleans	Granite, 4 x 8 x 4	3.25	sq.yd.
Cincinnati	Granite	3.84	sq.yd.
St. Louis	4x8x4 dressed	3.25	sq.yd.
	4x6x4 common	3.00	sq.yd.
Kansas City	No. Granite	3.95	sq.yd.
Philadelphia	Granite	125.00	per M.

FLAGGING—

New York	Bronx	$0.25	sq.ft.
	Manhattan, 4 ft.	.26	sq.ft.
	Queens, 5 ft.	.26	sq.ft.
	6x20-in. cross-walk	1.00	lin.ft.
Chicago	18 in. wide	.99	lin.ft.

CURBING—Bluestone per lineal foot, in New York, costs 77c. for 5x16 in., 88c. for 5x18 in.; in cargo lots.

WOOD BLOCK PAVING—

	Size of Block	Treatment	Per Sq.Yd.
New York (*delivered*)	3	16	$2.04
New York (*delivered*)	3½	16	2.17
New York (*delivered*)	4	16	2.36
Boston	3	16	2.17
Chicago	4	16	3.00@3.25
Chicago	3½	16	2.50@2.75
St. Louis	3½	16	2.50
St. Louis	4	16	3.00
Seattle	4	16	Off market
Minneapolis	3½	16	2.13
Atlanta	3½	16	2.30
New Orleans	3	16	1.60
New Orleans	3½	16	1.80
New Orleans	4	16	2.00
Dallas	4	18	3.90
Baltimore	3½	16	3.44
Montreal	4	16	4.50
Detroit	3	16	2.84
Detroit	4	16	3.00
Cincinnati	4	16	2.30
Kansas City	4	16	2.15
Philadelphia	3½	16	3.50

CONSTRUCTION MATERIALS

SAND AND GRAVEL—Price for cargo or carload lots to contractor is as follows, per cu.yd.:

	Gravel 1½ In. Current	Gravel 1½ In. One Year Ago	Gravel ¾ In. Current	Gravel ¾ In. One Year Ago	Sand Current	Sand One Year Ago
New York	$1.75	$3.00	$1.75	$3.00	$1.00	$1.25
Denver	2.50	2.00	2.50	1.80	1.10	1.60
Chicago	2.00	2.75	2.00	2.75	2.00	2.75
St. Louis, *per ton*	1.25	1.65	1.30	1.70	1.20	1.70
Seattle	1.50	1.50	1.50	1.50	1.50	1.50
Dallas	2.00	1.75	2.00	1.75	2.00	1.75
Minneapolis	1.50	2.00	1.50	....	1.00	1.00
Cincinnati	2.00	2.00	2.00	2.00	1.69	1.30
San Francisco	2.25	2.50	2.25	2.50	1.50	1.65
Boston	2.40	2.65	2.40	2.65	1.65	2.00
New Orleans	2.08‡	3.00	2.08‡	....	1.35	1.75
Los Angeles, per ton	1.50†	1.45	1.50†	1.45	1.35†	1.30
Atlanta, per ton	1.85	2.88	1.85	1.15	1.15	1.50
Detroit	2.00	1.85*	2.00	1.85*	2.00	2.50
Baltimore, per ton	1.40	1.40‡	1.60	1.60‡	2.00	
Montreal, per ton	1.25	1.50‡	1.50	1.75	1.25	1.50‡
Birmingham, per ton (Crushed slag used instead of gravel)					1.25	1.25‡
Philadelphia	1.50	1.55			1.60	
Kansas City	2.00	3.25	2.00	3.75	1.20	1.25

* Fine white sand: Pacific, $4 per ton; Ottawa, $4.50

† Freight from quarry to Los Angeles is 85c. per ton, and is included in above price.

‡ Per cu. yd.

CRUSHED STONE—Price for cargo or carload lots f.o.b. city, unless stated otherwise, is as follows, per cu.yd.:

	1½ In. Current	1½ In. One Year Ago	¾ In. Current	¾ In. One Year Ago
New York	$1.75@1.85	$1.90@2.00	$1.75@1.85	$2.15
Chicago	1.60	2.75	1.60	2.75
St. Louis *delivered*	1.65	1.85	1.65	1.85
Dallas, *delivered*	2.93	2.25	2.93	2.25
San Francisco	2.25	2.50	2.25	2.50
Boston, *delivered*	3.00*	3.00* (del.)	3.00*	3.00* (del.)
Minneapolis, *at plant*	2.00	2.00	2.25	2.25
Kansas City, *at plant*	2.10	2.35	2.10	2.35
Denver	3.50		3.50	
Seattle *delivered*	3.00	3.50 (del.)	3.00	3.50 (del.)
Atlanta	1.90*	3.25*	1.90*	
Cincinnati *delivered*	2.37½	2.30	2.08	2.15
Los Angeles	1.75†	1.70*	1.85*	1.80*
Detroit	1.90*	2.00	1.90*	2.00*
Baltimore	1.75*	1.75*	1.65*	1.75*
Montreal	2.00*	2.10*	2.10*	2.40*
Birmingham *delivered*	3.20	....	3.10	....
Phildelphia	1.70*	....	1.55*	....

*Per ton.

CRUSHED SLAG—Price of crushed slag in carload lots, per net ton, at plants:

	1½-In.	¾-In.	Roofing	Sand
Youngstown District	$1.30	$1.30	$2.00	$1.30
Steubenville District	1.40	1.40	2.00	1.40
Ironton District	1.40	1.40	2.00	1.40
Emporium, Pa.	1.25	1.25		1.25
Easton, Catasaqua, Pa	1.00	1.00	2.00	0.90
Birmingham, Ala.	1.05	1.15	2.05	0.80
Buffalo, N. Y., and Erie, Pa.	1.25	1.25	2.25	1.25
Cleveland, Ohio	1.20	1.20	....	1.00
Eastern Pennsylvania and Northern New Jersey	1.20	1.20	2.00	1.20
Western Pennsylvania	1.25	1.25	2.00	1.25

LIME—Warehouse prices:

	Hydrated, per Ton Finishing	Hydrated, per Ton Common	Lump, per Barrel Finishing	Lump, per Barrel Common
New York	$15.80@$16.80	$12.50	$3.68@$3.98	$2.75@$3.48*
Chicago	18.00	....	....	1.40†
St. Louis	23.20	20.00	2.50†	2.50†
Boston	23.00	20.00	3.35†	3.10†
Dallas	25.00	....	....	2.50†
Cincinnati	15.10	....	....	12.50‡
San Francisco	22.00	18.00	....	1.75†
Minneapolis	29.00	22.00 (white)	1.70†	1.40†
Denver	24.00	....	....	2.70†
Detroit	18.00	16.00	....	17.00‡
Seattle	27.00	....	3.00*	2.75†
Los Angeles	30.00	30.00	....	3.00*
Baltimore	15.00	13.00	....	12.00‡
Montreal	26.00	21.00	15.00‡	11.00‡
Atlanta	18.00	16.00	2.00†	1.25†
New Orleans	....	17.25	....	1.75†
Philadelphia	13.00	11.50	10.50‡	9.50‡

*280-lb. bbl. (net). †Per 180-lb. bbl. (net). ‡Per ton—Refund of 10c. per bbl.
Minneapolis quotes brown lime; Kelly Is. white is $1.70, Sheboygan $1.55.
Seattle quotes hydrated finishing lime in cloth sacks; paper sacks, $24.00 per ton.

NATURAL CEMENT—Price to dealers per bbl. for 500 bbl. or over, f.o.b., exclusive of bags:

	Current	One Year Ago
Minneapolis (Rosendale)	$2.80	$2.80
Kansas City (Ft. Scott)	1.60	1.60
Atlanta (Magnolia)	11.00 ton	11.00
Cincinnati (Utica)	1.93	2.75
Boston (Rosendale) per bag	.85	2.35

PORTLAND CEMENT—Prices to contractors per bbl. in carload lots f.o.b. points listed *without bags*. Cash discount not deducted.

	Current	One Month Ago	One Year Ago
New York*	$2.30	$2.20@2.30	$3.10
New York, alongside dock to dealers	2.00	2.00	....
Jersey City	2.12	2.12	2.89*
Boston	2.50	2.50	3.87
Chicago	1.94	1.97	2.17
Pittsburgh	2.02	2.02	2.17
Cleveland	2.26	2.26	2.43
Detroit	2.17	2.17	2.51
Indianapolis	2.21	2.21	2.31
Toledo	2.20	2.20	2.51
Milwaukee	2.13	2.18	2.39
Duluth	1.95	1.95	2.10
Peoria	1.98	2.13	2.43
Cedar Rapids	2.11	2.26	2.51
Davenport	2.06	2.21	2.47
St. Louis	2.20	2.20	3.40
San Francisco	2.73	2.84	3.09
New Orleans	3.20	3.20	3.60
Minneapolis	2.24	2.24	2.41
Denver	2.90	2.90	3.10
Seattle	2.94	2.94	3.10
Dallas	2.40	2.40	2.85
Atlanta	2.39	2.69	3.00
Cincinnati	2.32	2.35	2.57
Los Angeles	3.30	3.31	3.21
Baltimore*	2.50	2.50	2.93
Birmingham	2.27	2.27	....
Kansas City	2.40	2.40	2.76
Montreal	2.40	3.10*	3.50*
Philadelphia	2.21	2.21	....
St. Paul	2.24	....	2.41

NOTE—Bags 10c. each, 40c. per bbl.:

Current mill-prices per barrel in carload lots, without bags; to contractors:	
Buffington, Ind.	$1.70
Universal, Pa.	1.75
Steelton, Minn.	1.75
Fordwick, Va.	1.95
Hudson, N. Y.	1.90
Lehigh Valley District	1.70
Kingsport, Tenn.	1.95
Richard City, Tenn.	1.95

*Delivered by truck at site of work.

TRIANGLE MESH—Price per 100 sq.ft. in carload lots:

PLAIN 4-INCH BY 4-INCH MESH

Style Number	Weight in Pounds per 100 sq.ft.	Pittsburgh, Mill	Warehouse: New York	Chicago	St. Louis	Dallas	San Francisco
032	22	$0 68	$1 08	$0 76	$0.68	$1 15	$1.15
049	28	.87	1 33	.98	.87	1 46	1 48
068	35	1 05	1 58	1 18	1.05	1 80	1 80
093	45	1 35	1 99	1 52	1.35	2 30	2 32
126	57	1 65	2.43	1 87	1.65	2 86	2 87
153	68	1 97	2.88	2 23	1.97	3 40	.....
180	78	2 26	3.28	2 56	2.26	3.93	.....
245	103	2.99	4 29	3 38	2.99	5 15	.....
287	119	3 45	4 95	3 90	3.45	5 96	6 01
336	138	4.00	5.72	4 52	4.00	7 32	.....
395	160	4.64	6.61	5 20	4.64	8.00	.....
PAVING							
036P	17	$0.52	$0.83	$0.58	$0.52	$0.88	.....
053P	24	.73	1 14	.82	.73	1 24	.....
072P	31	.91	1 40	1 00	.91	1 57	.....
097P	40	1.18	1.77	1 29	1.18	2 02	.....
049R	24	.73	1 14	.67	.73	1 24	.....
067R	31	.91	1 40	1.00	.91	1 57	.....
084R	40	1.18	1 77	1.29	1.18	2 02	.....

In rolls 16-, 20-, 24-, 28-, 32-, 36-, 40-, 44-, 48-, 52-, and 56-in. wide and in 150-, 200- and 300-ft. lengths. Galvanized is about 15% higher. Size of roll carried in New York warehouses, 48 in wide x 150 ft. long, or 600 sq. ft.

EXPANDED METAL LATH—Prices in carload lots per 100 yd. for painted are as follows:

Gage	Weight	*New York	Chicago	St. Louis	San Francisco	Dallas
27BB	2.3	$21 20	$23 36	$21 22	$23 87	$25 50
26BB	2.5	22 65	24 90	22 64	26 21	27 50
25BB	3.0	25 30	27 42	.....	.....	30 71
24BB	3.4	27 10	29 33	27 10	27 90	33 16
22PO	4.33	31.75	34 06	.....	.....	35 10

* Price to contractors at warehouse or delivered on job in Manhattan, Bronx or Brooklyn.

BARS, CONCRETE REINFORCING—Current quotations per 100 lb.:

ROLLED FROM BILLETS

Inches	Pittsburgh Mill	Birmingham Mill	Warehouse, Uncut: New York	Chicago	St. Louis	Dallas	San Francisco
½ and larger	$1.40@$1.50	$1 70	$2 53	$2 53	$2.50	$3 50	$2 75
⅝ and larger	1.45@ 1.55	1 75	2 58	2.58	2.55	3 55	2 80
¾ and larger	1.50@ 1.60	1 85	2 63	2 63	2.60	3 60	2 85
⅞ and larger	1.65@ 1.75	1 95	2 68	2 78	2.85	3 75	3 00
1 and larger	1.90@ 2.00	2 05	2.73	3 03	3.00	4 00	3.25

Includes 15c charge for cutting to lengths of 2 ft. and over. Twisted bars cut to length take extra of 27½c. per 100 lb.

ROLLED FROM RAILS

	Chicago	St. Louis	Dallas		Chicago	St. Louis	Dallas
½ and larger	$1 60	$2 25	$3 25	½	$1 85	$2 60	$3 50
⅝ in	1 65	2 36	3 30	¾	2 10	2 75	3 75
1	1 70	2 35	3 35				

BRICK—Contractors price per 1,000 in cargo or carload lots is as follows:

	Common: Current	One Month Ago	One Year Ago	Paving Block: 3-inch*	4-inch*
New York (del.)	$21.40	$20.40	$22.70	$44 50	$49 50
New York (at dock)	18 00	14@15	.....	.....	.....
Chicago	11 00	11 00	15 00	34 00	42 00
St. Louis, salmon	17 00	16 00	15 00	37.50	37.50
Denver, salmon	14 00	14 00	14 00	.....	.....
Dallas	11 00	11 00	25 00	no market	
San Francisco	15 50	15 50	18 00	.....	44 38
Los Angeles	15 00	15 50	15 50	(not used)	
Boston (del.)	16 00	17 00	25 00	46.50	52 60
Minneapolis (del.)	15 00	15 00	20@22	.....	43 00
Kansas City	14 50	14 50	22 00	.....	.....
Seattle	14 00	14 00	19 00	48 00	53 50
Cincinnati	17 00	17 00	21@22	41 00	36.50
Montreal (del.)	16 00	16 00	20 00	100 00	120 00
Detroit (del.)	16.50	16.50@17	18 00	37 00	40 00
Baltimore (del.)	20 00	20 00	20@25	36 00‡	.....
Atlanta	8 25	9 00	13 00	.....	.....
New Orleans	12 50	12 50	24 00	.....	.....
Birmingham	10 50	10 50	.....	.....	.....
Philadelphia	16.00	16.00	.....	.....	42.00

* For paving blocks 3½x8½x3 and 3½x8½x4 respectively. ‡ Vitrified, f.o.b. plant, Baltimore.

HOLLOW TILE—Price per block in carload lots to contractor for hollow building tile.

	New York: Current on Trucks*	New York: One Year Ago	Chicago	Philadelphia	St. Louis	San Francisco	Perth Amboy N. J., Factory*
4x12x12	$0 11120	$0.2444	$0 0821	$0 095	$0 08	$0 108	.....
6x12x12	16670	.3259	0950	.....	.11	156	.....
8x12x12	20840	.4345	1295	.175	.145	244	$0.17890
10x12x12	.....	.....	1584	.....	.19	.....	21050
12x12x12	.....	.....	1811	.255	.22	.....	27370

* 5 per. off for cash.

	4x12x12	8x12x12	12x12x12
Boston	$0.0960	$0.182	$0.248
Minneapolis (f.o.b. cars)	.0672	.105	168
Minneapolis (delivered)	.0752	.1175	188
Cincinnati	.0670	.126	175
Kansas City	.085	.167	.270
Denver	.08	.145	.21
Seattle	.10	.175	.30
Los Angeles factory	.095	.176	.22
New Orleans	.13	.26	.40
Detroit (delivered)	.070	.135	.225
Montreal	.20	.30	.35
Baltimore	.14	.25	.39
Atlanta	.06525	.1015	.....
Dallas	.13	.....	.....
Birmingham	.095	.1785	.....

San Francisco, Philadelphia and New York quote on hollow partition tile.

STRUCTURAL MATERIAL—Following are base prices f. o. b. mill, Pittsburgh and Birmingham together with quotations per 100 lb. from warehouses at places named:

	Pittsburgh, Mill	Birmingham Mill	New York	Dallas	St. Louis	Chicago	San Francisco
Beams, 3 to 15 in.	1.40@1.50	$1.75	$2 63	$4 00	$2.72½	$2 63	$3 10
Channel, 3 to 15 in.	1.40@1.50	1.75	2 63	4 00	2.72½	2 63	3 10
Angles, 3 to 6 in., ¼ in. thick	1.40@1.50	1.75	2.63	4 00	2.72½	2 63	3 10
Tees, 3 in. and larger	1.40@1.50	1.75	2 63	4.00	2.72½	2 63	3 10
Plates	1.40@1.50	1.75	2 63	4.00	2.72½	2.63	3 10

RIVETS—The following quotations are per 100 lb.:

STRUCTURAL

	Pittsburgh, Mill	New York: Current	New York: One Yr. Ago	Chicago	St. Louis	San Francisco	Dallas
½ in. and larger	$2.25	$3.50	$5 08	$3.43	$3.52½	$4 50	$5.50
CONE HEAD BOILER							
½ in. and larger	2.35	3.60	5 30	3 53	3.62½	4 60	5.65
⅝ and ¾	2.50	3.76	5 45	3.68	3.62½	4 75	5 80
⅞ and 1	2.75	4 00	5 70	4 18	3.62½	6 00	6.05

Lengths shorter than 1 in. take an extra of 50c. Lengths between 1 in. and 2 in. take an extra of 25c.

NAILS—The following quotations are per keg from warehouse:

	Pittsburgh, Mill	Chicago	San Francisco	Dallas	St. Louis	Montreal
Wire	$2 50	$3.15	$3 90	$5 00	$3 62	$4.95
Cut	2 25	5.80	5 90	7.75	....	5.00

PREPARED ROOFINGS—Standard grade rubbered surface, complete with nails and cement, costs per square as follows:

	New York: 1-Ply l.c.l.	New York: 2-Ply l.c.l.	New York: 3-Ply l.c.l.	Philadelphia: 1-Ply l.c.l.	Philadelphia: 2-Ply l.c.l.	Philadelphia: 3-Ply l.c.l.
No. 1 grade	$2 02	$2 38	$2.80	$1 92	$2 28	$2.70
No. 2 grade	1.77	2 08	2 45	1 67	1 98	2 35

Slate-surfaced roofing (red and green) in rolls of 108 sq.ft. costs **$1.95** per roll in carload lots and **$2.20** for smaller quantities f.o.b. Philadelphia.

Shingles, red and green slate finish, cost **$5.50** per square in carloads; **$5.75** in smaller quantities, in Philadelphia.

ROOFING MATERIALS—Prices f.o.b. New York:

Tar felt (14 lb. per square of 100 sq.ft.) per roll of 432 sq.ft.	$2 00
Tar pitch (in 400-lb. bbl.), per 100 lb.	1 85
Asphalt roofing (in barrels), per ton, f.o.b. plant*	47.50
Asphalt felt (light), per ton, f.o.b. plant*	67.00
Asphalt felt (heavy), per ton, f.o.b. plant*	68.50

* Delivered in Metropolitan Dist., $3,00 additional.

SHEETS—Quotations are per 100 lb. in various cities from warehouse also the base quotations from mill:

Blue Annealed	Pittsburgh, Large Mill Lots	St. Louis	Chicago	San Francisco	New York
No. 10	$2.25	$3.47½	$3.38	$3.95	$3 28
No. 12	2 30	3.52½	3 43	4 00	3 33
No. 14	2.35	3.57½	3.48	4.05	3 38
No. 16	2.55	3.67½	3.58	4.15	3 48
Black					
*Nos. 18 and 20	2 85	3 55	3 95	5 85	3 80
*Nos. 22 and 24	2 90	3 70	4 00	5 35	3 85
*No. 26	2 95	3 85	4 05	5 35	3 90
*No. 28	3 00	4 15	4.15	5 45	4 00
Galvanized					
No. 10	3.00	4.15	4.15	...	4 00
No. 12	3.10	4.25	4.25	5.40	4.10
No. 14	3.10	4.25	4.25	5.40	4.10
Nos. 17 to 21	3 40	4.45	4 55	5 70	4 40
Nos. 22 and 24	3 55	4.70	4 70	5.85	4.55
*Nos. 25 and 26	3 70	4.85	4.85	6.00	4.70
*No. 28	4 00	5.15	5.15	6 30	5 00

*For painted corrugated sheets add 30c. per 1,000 lb. for 5 to 28 gage; 25c. for 19 to 24 gages; for galvanized corrugated sheets add 15c., all gages.

LINSEED OIL—These prices are per gallon:

	New York: Current	New York: One Year Ago	Chicago: Current	Chicago: One Year Ago
Raw in barrel (5 bbl. lots)	$0.87	$0.73	$0 91	$0.75

WHITE AND RED LEAD—Base price in cents per pound:

	Red — Current		Red — 1 Year Ago		White — Current	White — Yr. Ago
	Dry	In Oil	Dry	In Oil	Dry or In Oil	Dry or In Oil
100-lb. keg	12.25	13.75	13.00	14.50	12.25	13.00
25 and 50-lb. kegs	12.50	14.00	13.25	14.75	12.50	13.25
12½-lb. keg	12.75	14.25	13.50	15.00	12.75	13.50
5-lb. cans	15.25	16.75	16.00	17.50	15.25	16.00
1-lb. cans	17.25	18.75	18.00	19.50	17.25	18.00

LUMBER

Prices wholesale to dealers in carload lots, f.o.b.

San Francisco—Prices of rough Douglas fir No. 1 common, in more than carload lots. To contractors, $2 per M ft. additional.

Lumber Prices to Contractors in Yards at San Francisco

	6–8 and 12 Ft.	10–16–18 and 20 Ft.	22 and 24 Ft.	25 to 32 Ft.
3x3 and 4	$27.00	$27.00	$28.00	$33.00
3x6 and 8	28.00	28.00	29.00	34.00
4x4-6 and 8	28.00	29.00	30.00	35.00
3x10 and 12	28.00	29.00	30.00	35.00
3x14	32.00	33.00	34.00	36.00
4x10 and 12	28.00	29.00	30.00	35.00
4x14	32.00	33.00	34.00	36.00

	24 Ft. and Under	25 to 32 Ft.	33 to 40 Ft.
6x10	$30.00	$33.00	$35.00
6x14	32.00	35.00	37.00
8x10	30.00	33.00	35.00
3x14	32.00	35.00	37.00

New York, Chicago, St. Louis and Detroit—Wholesale prices to dealers of long leaf yellow pine.

	New York* — 20 Ft. and Under	New York* — 22–24 Ft.	Chicago — 20 Ft. and Under	Chicago — 22–24 Ft.
3x 4 to 8x8	$38.00	$39.00	$39.00	$41.00
3x10 to 10x10	41.00	42.00	41.00	43.00
3x12 to 12x12	44.00	45.00	43.00	45.00
3x14 to 14x14	47.50	48.50	47.00	49.00
3x16 to 16x16	52.50	53.50	52.00	54.00
3x18 to 18x18	60.00	61.00	58.00	60.00
4x20 to 20x20	70.00	71.00	65.00	67.00

* Wholesale price to dealers; to contractors, on lighters or cars, about $5 additional. Short leaf pine up to 14 x 14 costs $15 per M. less.

St. Louis: Yellow pine, 10@20 ft. long, 3 x 4 to 6 x 6, $20.00; 3 x 8 to 8 x 8, $19; 3 x 12 to 5 x 12, $25; 3 x 14 to 5 x 14, $28; 3 x 16 to 4 x 16, $32; 12 x 14 to 14 x 14, $27; 3 x 10 to 10 x 10, $21; 3 x 18 to 4 x 18, $38; 12 x 16 to 16 x 16, $31.

Detroit—Norway pine 2 in. x 4 in., 10 ft. x 16 ft. long, $35, 2 in. x 12 in., 10 ft. x 16 ft. long, $37; short leaf yellow pine 2 in. x 4 in, 9 ft. x 12 ft. long, $27.50 2 in. x 8 in., 18 ft. x 20 ft. long, $31; yellow pine flooring No. 1 common 1 in. x 3 in., $39.75, 1 in. x 4 in., 6 ft. x 12 ft. long, $37.25; yellow pine shiplap $37.00.

Over 24 ft.—Add $1 for each additional 2 ft. in length up to 30 ft. for sizes 12 x 12 and under, for sizes over 12 x 12 add $2. for merchantable add $2 to sizes 10 x 10 and under. For pine add $2 to the price of merchantable for all sizes.

Other Cities

	8 x 8-In. x 20 Ft. and Under — P.	Fir	Hemlock	Spruce	12 x 12-In. 20 Ft. and Under — P.	Fir
Boston	$50.00	$52.00	$55.00	$45.00	$54.00	$52.00
Seattle		20.00				20.00
New Orleans	28.00				25.00	
Baltimore	36.45				38.50	
Cincinnati	42.00	50.00			46.00	64.00
Montreal	78.00	85.00	68.00	78.00	78.00	
Los Angeles		44.00	43.00			44.00
Denver		33.75	33.75	33.75	50.00	34.75
Minneapolis	40.00	40.00	38.00		47.00	38.00
Atlanta	31.00				37.00	
Dallas	33.00				34.00	
Kansas City	33.00	34.00			36.00	35.00
Birmingham	20.00				26.00	
Philadelphia	32.00	35.00	39.00	42.00	38.00	35.00

	1-In. Rough, 10 In. x 16 Ft. and Under — P.	Fir	Hemlock	2-In. T. and Gr., 10 In. x 16 Ft. — P.	Fir
Boston	$47.00	$48.00	$32.00	$45.00	$48.00
Seattle		15.00			20.00
New Orleans, at mill	65.00			32.00	19.50
Baltimore	35.00			36.45	
Cincinnati	62.50	80.00		33.50	
Montreal		60.00	60.00	80.00	80.00
Los Angeles		37.00	36.00		65.00
Denver		29.25	29.25		30.25
Minneapolis	38.50	36.25	34.25	36.00	34.75
Atlanta	18.00			22.00	
Dallas	32.00	30.00		36.00	
Kansas City	35.00	34.50		20.00	31.00
Birmingham	18.00			18.00	
Philadelphia	30.00	35.40	37.00	28.00	26.00

Montreal—Up to 32 ft.; over which, $3.00 per M. increase up to 30 ft.

Birmingham—Quotes carload lots, f.o.b. sidings. $2 additional per M. ft. for delivery.

Boston and Cincinnati—Prices to contractors in carload lots, f.o.b.

Denver—Quotes dealers prices to contractor on large projects.

FREIGHT RATES

On finished steel products in the Pittsburgh district, including plates, structural shapes, merchant steel, bars, pipe fittings, plain and galvanized wire nails, rivets, spikes, bolts, flat sheets (except planished), chains, etc., the following freight rates are effective in cents per 100 lb., in carloads of 36,000 lb.:

Baltimore	$0.33½	Detroit	$0.32½
Birmingham	.76½	Kansas City	.81½
Boston	.40½	New Orleans	.51½
Buffalo	.29½	New York	.38
Chicago	.38	Pacific Coast (all rail)	1.66½†
Cincinnati	.325	Philadelphia	.35
Cleveland	.24	St. Louis	.47½
Denver	1.35*	St. Paul	.66½

* Minimum carload, 40,000 lb.

†Minimum carload, 50,000 lb., structural steel only; 80,000 lb. for other iron steel products.

CONTRACTORS' SUPPLIES

STEEL SHEETPILING—The following price is base per 100 lb. f. o. b. Pittsburgh, with a comparison of a month and a year ago:

Current	One Month Ago	One Year Ago
$1.80	$1.55@1.80	$3.00

WIRE ROPE—Discounts from list price on regular grades of bright and galvanized are as follows:

	Eastern Territory New York and East of Missouri River
Hercules red strand, all constructions	30%
Patent flattened strand, special and cast steel	30%
Patent flattened strand, iron rope	15%
Plow steel round strand rope	45%
Special steel round strand rope	40%
Cast steel round strand rope	32½%
Round strand iron and iron tiller	15%
Galvanized steel rigging and guy rope	17½%
Galvanized iron rigging and guy rope	+2½%

California, Oregon, Nevada and Washington: Discount 5 points less than discount for Eastern territory.

Wyoming, New Mexico and Colorado: Discount 5 points less than discount for Eastern territory.

Arizona: Discount 10 points less than discount for Eastern territory.

Montana, Idaho and Utah: Discount 10 points less than discount for Eastern territory.

North Dakota, Nebraska, Kansas, Okla'oma and Texas: Discount 5 points less than discount for Eastern territory.

MANILA ROPE—For rope smaller than ¾-in. the price is ½ to 2c. extra; while for quantities amounting to less than 600 ft., there is an extra charge of 1c. The number of feet per pound for the various sizes is as follows: ½-in., 8 ft., ⅝-in., 6; ¾-in., 4½; 1-in., 3½; 1¼-in., 2 ft. 10 in.; 1½-in., 2 ft. 4 in. Following is price per pound for ½-in. and larger, in 1200-ft. coils:

Boston	$0.20	New Orleans	$0.17½
New York	18½	Los Angeles	16½
Chicago	19	Seattle	16½
Minneapolis	19½	St. Louis	19½
San Francisco	17	Montreal	30
Atlanta	19	Detroit	19
Denver	20	Baltimore	20
Cincinnati	20	Kansas City	18½
Dallas	29	Birmingham	20½
Philadelphia	17½		

EXPLOSIVES—Price per pound of dynamite in small lots:

	Gelatin 40%	Gelatin 60%
New York	$0.2950	$0.3250
Boston	.24	.275
Kansas City	.24	.2750
Seattle	.1575	.1875
Chicago	.2450	.2750
Minneapolis	.2274	.2530
St. Louis	.2475	.2775
Denver	.2250	.2550
Dallas	.29	.375
Los Angeles	.25	.29
Atlanta	.2575	.2925
Baltimore	.2550	.27
Cincinnati	.2450	.28
Montreal	.215	.255
Birmingham, *delivered*	.165	.205
New Orleans	.2725	.3075
San Francisco	.195	.23
Philadelphia	.2525	.2875

PILES—Prices per lineal foot, pine piles with bark on, f.o.b. New York.

Diameters	Points	Length	Barge	Rail
12 in. at butt	6 in.	30 to 50 ft.	$0.14	$0.19
12 in.—2 ft. from butt	6 in.	50 to 59 ft.	0.18½	0.25
12 in.—2 ft. from butt	6 in.	60 to 69 ft.	0.21	0.27½
14 in.—2 ft. from butt	6 in.	50 to 69 ft.	0.24	0.32½
14 in.—2 ft. from butt	6 in.	70 to 79 ft.	0.26	0.34½
14 in.—2 ft. from butt	5 in.	80 to 89 ft.	0.33	0.42

SCRAP—The prices following are per gross ton paid to dealers and producers in New York. In Chicago and St. Louis the quotations are per net ton and cover delivery at the buyer's works, including freight transfer charges.

	New York	Chicago	St. Louis
No. 1 railroad wrought	$10.50	$11.50	$12.00
Stove plate	10.50	12.00	12.00
No. 1 machinery cast	16.50	16.50	14.50
Machine shop turnings	4.00@5.00	4.00	4.00
Cast borings	7.50@8.00	5.50	7.00
Railroad malleable cast	8.50	12.50	9.00
Re-rolling rails	9.50@10.00	13.00	15.00
Relaying rails	27@28	30.00	15.00

SHIP SPIKES—Current prices per 100 lb.:

In.	San Francisco — Galv.	San Francisco — Black	Seatt'e Blac'
	$9.10	$7.40	$8.55
½	8.65	6.65	8.25
⅝	8.50	6.50	8.3
¾			

Pittsburgh base in lots of 200 kegs or more $2.25@2.30